



TM-348  
1st printing



**KLAX**  
*Universal Kit  
Installation  
Instructions*

**KLAX**™

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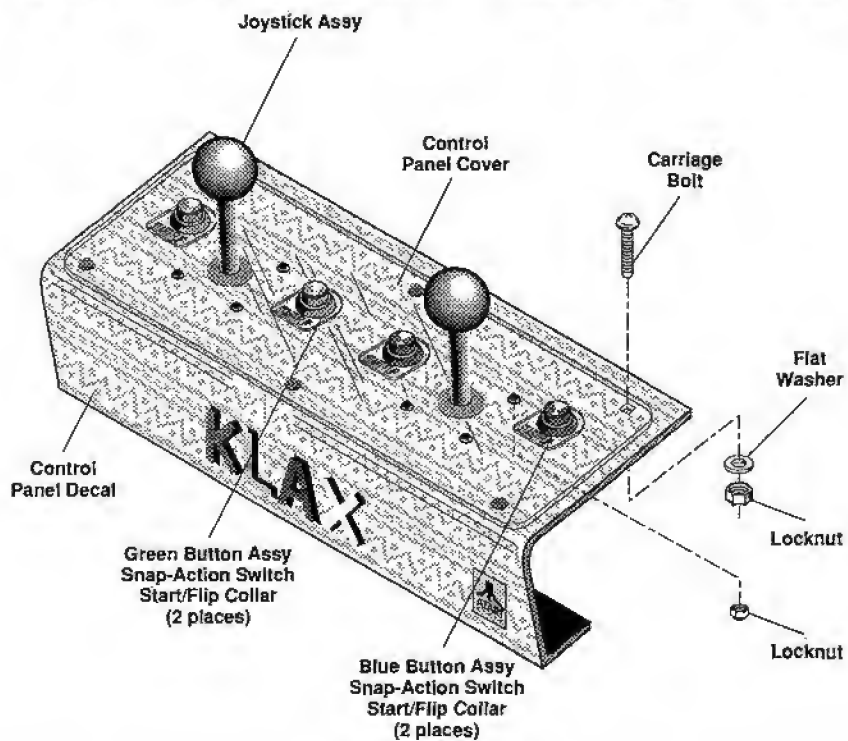
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# KLAX™



*Universal Kit Installation Instructions*

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## Notice Regarding Non-Atari® Parts

### **WARNING**

*Use of non-Atari parts or modifications of any Atari game circuitry may adversely affect the safety of your game, and may cause injury to you and your players.*

You may void the game warranty (printed on the inside back cover of this manual) if you do any of the following:

- Substitute non-Atari parts in the game.
- Modify or alter any circuits in the game by using kits or parts *not* supplied by Atari Games Corporation.

### **NOTE**

This equipment generates, uses, and can radiate radio frequency energy, and if not installed and used in accordance with the instruction manual, may cause interference to radio communications. It has been tested and found to comply with the limits for a Class A computing device pursuant to Subpart J of Part 15 of Federal Communications Commission (FCC) Rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area or modification to this equipment is likely to cause interference, in which case the user, at his own expense, will be required to take whatever measures may be required to correct the interference. If you suspect interference from an Atari game at your location, check the following:

- All ground wires in the game are properly connected as shown in the game wiring diagram.
- The power cord is properly plugged into a grounded three-wire outlet.
- On games provided with an Electromagnetic Interference (EMI) ground cage, be sure that the game printed-circuit boards (PCBs) are properly installed on the EMI ground cage and that the end board is securely installed with **all** screws in place and tightened.

If you are still unable to solve the interference problem, please contact Customer Service at Atari Games Corporation. See the inside front cover of this manual for service in your area.

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# Safety Summary

The following safety precautions apply to all game operators and service personnel. Specific warnings and cautions will be found in this manual whenever they apply.

## WARNING

**Properly Ground the Game.** Players may receive an electrical shock if this game is not properly grounded! To avoid electrical shock, do not plug in the game until it has been inspected and properly grounded. This game should only be plugged into a grounded three-wire outlet. If you have only a two-wire outlet, we recommend you hire a licensed electrician to install a three-wire grounded outlet. If the control panel is not properly grounded, players may receive an electrical shock! After servicing any part on the control panel, check that the grounding wire is firmly secured to the inside of the control panel. After you have checked this, lock up the game.

**AC Power Connection.** Before you plug in the game, be sure that the game's power supply can accept the AC line voltage in your location. The line voltage requirements are listed in the first chapter of this manual.

**Disconnect Power During Repairs.** To avoid electrical shock, disconnect the game from the AC power before removing or repairing any part of the game. If you remove or repair the video display, be very careful to avoid electrical shock. High voltages continue to exist even after power is disconnected in the display circuitry and the cathode-ray tube (CRT). Do not touch the internal parts of the display with your hands or with metal objects! Always discharge the high voltage from the CRT before servicing it. Do this after you disconnect it from the power source. First, attach one end of a large, well-insulated, 18-gauge jumper wire to ground. Then momentarily touch the free end of the grounded jumper wire to the CRT anode by sliding the wire under the anode cap. Wait two minutes and do this again.

**Use Only Atari Parts.** To maintain the safety of your Atari game, use only Atari parts when you repair it. Using non-Atari parts or modifying the game circuitry

may be dangerous, and could injure you and your players.

**Handle the CRT With Care.** If you drop the CRT and it breaks, it may implode! Shattered glass from the implosion can fly six feet or more.

**Use the Proper Fuses.** To avoid electrical shock, use replacement fuses which are specified in the parts list for this game. Replacement fuses must match those replaced in fuse type, voltage rating, and current rating. In addition, the fuse cover must be in place during game operation.

## CAUTION

**Properly Attach All Connectors.** Make sure that the connectors on each printed circuit board (PCB) are properly plugged in. The connectors are keyed to fit only one way. If they do not slip on easily, do not force them. If you reverse a connector, it may damage your game and void your warranty.

**Ensure the Proper AC Line Frequency.** Video games manufactured for operation on 60 Hz line power (used in the United States) must not be operated in countries with 50 Hz line power (used in Europe). If a 60 Hz machine operates on 50 Hz line power, the fluorescent line ballast transformer will overheat and cause a potential fire hazard. Check the product identification label on your machine for the line frequency required.

## ABOUT WARNINGS, CAUTIONS, AND NOTES

In Atari publications, notes, cautions and warnings have the following meaning:

**WARNING** — Players and/or technicians can be killed or injured if instructions are not followed.

**CAUTION** — Equipment and/or parts can be damaged or destroyed if instructions are not followed. You will void the warranty on Atari printed-circuit boards, parts thereon, and video displays if equipment or parts are damaged or destroyed due to failure of following instructions.

**NOTE** — A highlighted piece of information.

## *Chapter 1*

# Installation

## How to Use This Manual

This manual provides information for installing, testing, and troubleshooting the Klax™ Universal kit. The manual is divided into the following chapters: ■ Chapter 1 describes how to install the Klax kit in your cabinet and the Klax game play. ■ Chapter 2



describes the self-test screen. ■ Chapter 3 describes troubleshooting and maintenance procedures. ■ Chapter 4 contains illustrated parts lists. ■ Chapter 5 contains the schematics for the Klax game PCB.

**WARNING**

*To avoid electrical shock, unplug the cabinet while installing the kit. After installation, plug the game only into a grounded 3-wire outlet.*

## Cabinet Equipment Requirements

Table 1-1 lists the equipment required in the cabinet into which you are installing the Klax kit.

**Table 1-1 Equipment Requirements**

Equipment	Specification
Video Display	Color RGB monitor Separate positive horizontal and vertical sync or negative composite sync Horizontal mounting Horizontal frequency: 15.750 KHz Vertical frequency: 60 Hz Video input: 1V to 3V peak-to-peak positive polarity
Control Panel	Metal only
Speaker	8 $\Omega$ , 10 W
Coin Mechanism	+5 VDC or +12 VDC
Power Cord	Three-conductor with ground
Power Supply	+5 VDC $\pm$ 0.25V @ 3.0 amps +12 VDC @ 1.0 amp -5 VDC @ 1.0 amp (Optional)

**CAUTION**

*Do not unplug or plug in the Klax game printed-circuit board (PCB) edge connector while the power is on. You could seriously damage the PCB.*

## Tools Required

- Two C-clamps
- Drill with a 1/4-inch drill bit, a 1 3/4-inch hole cutter (or a 1 3/4-inch chassis punch), and a 1 3/16-inch hole cutter (or a 1 3/16-inch chassis punch)
- Phillips screwdriver
- Flat-blade screwdriver
- Socket wrench set and ratchet
- 1/4-20 hex wrench
- Wire cutters and strippers

- Straight edge
- Squeegee
- X-ACTO™ knife
- Fast-ons (if you are installing a new JAMMA harness)

## Inspecting the Kit

Check to see that you have all the parts listed in the kit parts list in Table 1-2. If any part is missing or damaged, contact your distributor with the Klax kit serial number, part number and description of the missing or damaged parts, and date received.

**Table 1-2 Kit Contents List**

Amount	Description	Part No.
1	JAMMA Harness Assy	A046501-01
1	Klax Game PCB Assy	A047441-01
1	Product I.D. Label	038158-01
1	FCC Compliance Label	039450-01
1	Attraction Shield	047205-01
1	Control Panel Cover	047209-01
1	Control Panel Decal	047590-01
2	Side Panel Decal	047594-01
1	Attraction Film With Graphics	047595-01
1	Bezel With Graphics	047621-01
4	Split Ferrite Bead	141026-001
4	Snap-Action Switch	160044-001
2	4-Way Joystick Assy	171057-003
12	#10 Flat Washer	175014-1040
12	#10-24 Hex Polymer Locknut	177010-240
2	Cable Wrap	178-32-002
2	Blue Button Assy	178237-005
2	Green Button Assy	178237-006
4	L-Style Nylon Standoff	178265-001
4	Orange Start/Flip Button Collar	178283-002
4	#6 x 3/4-Inch-Long Pan-Head Screw	72-6612S
12	#10-24 x 3/4-Inch-Long Black Carriage Bolt	75-5112B
1	Klax Universal Kit Installation Instructions	TM-348

## Preparing the Cabinet for the Kit Installation

1. Turn off power to the game.
2. Remove the following from the cabinet:
  - Old PCB(s).
  - Game harness, if it is not Japan Amusement Machinery Manufacturers Association (JAMMA)-compatible.



- Control panel decals, labels, and controls.
  - Side decals, graphics, and adhesive. If the cabinet sides are damaged, repair them before putting on the new decals.
  - Video display shield, display bezel, attraction shield, and marquee.
3. Wipe down and vacuum the cabinet. Paint the cabinet, if required.

## Assembling the Control Panel

You need the following parts from the kit to assemble the control panel:

- Clear cover for the control panel
  - Control panel decal
  - Two green buttons
  - Two blue buttons
  - Four snap-action switches
  - Four start/flip button collars
  - Two joystick assemblies
  - Twelve #10-24 x 1-inch-long carriage bolts, flat washers, and locknuts
1. Measure your control panel to find out what size the decal and cover should be. Cut the control panel decal and cover to fit.
  2. Clamp the control panel cover to the control panel.
  3. Drill four corner holes through the control panel and the control panel cover. Use a 1/4-inch drill bit.
  4. Install four carriage bolts and locknuts through the holes to hold the cover and the control panel together.
  5. Cut the holes in the cover and panel using a 1 3/16-inch hole cutter for the button holes and a 1 3/4-inch hole cutter for the joystick knob holes. Use a 1/4-inch drill bit to drill the mounting holes for the joysticks.
  6. Disassemble the control panel and the control panel cover.
  7. Install the control panel decal on the control panel. Use a sharp knife and cut out the holes for the controls in the decal.
  8. Install the cover on the control panel with four carriage bolts, washers, and locknuts.
  9. Install the buttons with a plastic start/flip collar under each button. Install the blue player control buttons on the left and the green player control

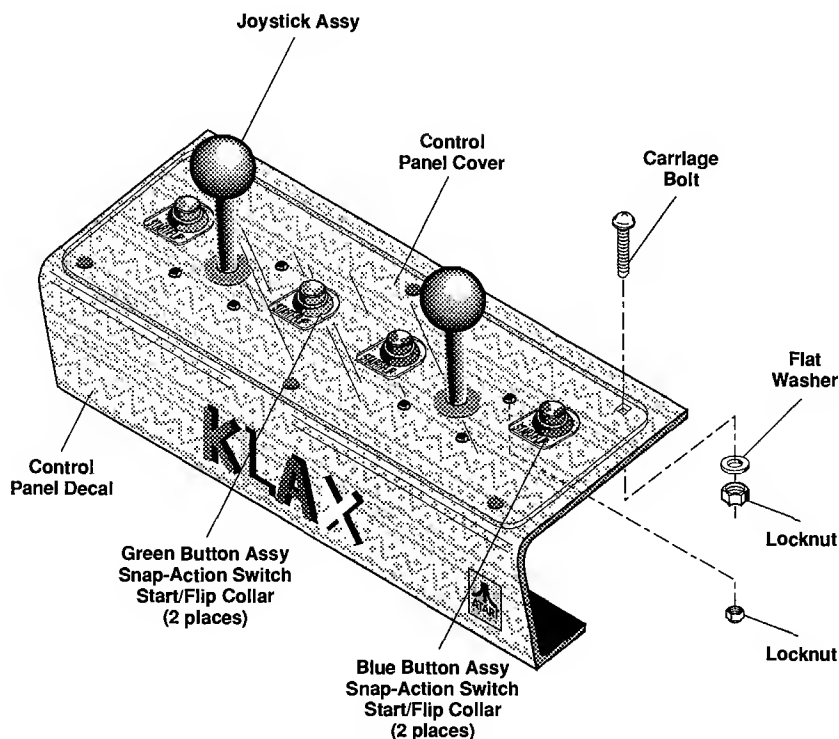


Figure 1-1 Assembling the Control Panel

buttons on the right. (See Figure 1-1.) Install the joysticks with the carriage bolts, washers, and lock-nuts.

connector as possible. Hold the beads on the harness with the tie wraps included in the kit.

## Connecting the JAMMA Harness

1. If your game does not already have a JAMMA harness, install the JAMMA harness in the cabinet.
2. Install the split beads on the harness as close to the

### CAUTION

You must install the split beads included in the kit on the JAMMA harness to meet FCC requirements.

3. Using Table 1-3, *JAMMA Pin and Wire Connections*, for wiring information, connect the JAMMA harness to existing component harnesses. Use

**Table 1-3 JAMMA Pin and Wire Connections**

Pin	Wire Color	Signal	Instructions
<b>Component Side</b>			
1	BN	GND	Connect to the 5V RTN (GND) terminal on the power supply. However, if you have 12V RTN, connect <i>one</i> of the BN wires at pin 1, 2, A, or B to the 12V RTN terminal.
2	BN	GND	Same as pin 1.
3	R	+5V	Connect to the +5V terminal on the power supply. However, if your power supply has a +SENSE terminal, connect <i>one</i> of the R wires at pin 3, 4, C, or D to +SENSE instead of +5V.
4	R	+5V	Same as pin 3.
5	OR	-5V	Connect to the -5V terminal of the power supply. If -5V is not available, connect to the 12V RTN or the 5 V RTN (GND) or leave it unconnected. <i>NOTE: If you do not have (or use) -5V, the maximum power to the speaker will be reduced by half.</i>
6	Y	+12V	Connect to the +12V terminal of the power supply. If your coin counter(s) require 12V, also connect to the + side of the coin counter(s).
7		<b>Key</b>	
8	BU/W	COIN CTR 1	Connect this wire to one side of the 12V coin counter. <i>Note: Do not use 24V counters.</i> If your counter requires 5V, connect a wire from the +5V terminal on the power supply.
9		Not used	
10	BN	SPKR +	Connect to the + terminal on the speaker. (This wire is part of a twisted pair.)
11		Not used	
12	R	RED	Attach to the video display.
13	BU	BLUE	Attach to the video display.
14	BK	VIDEO GND	Attach to the video display.
15	W	SELF-TEST	Use this wire if you want an external self-test switch. However, the kit already has a self-test switch on the PCB. <i>(If you connect an external self-test switch, switch off the switch on the PCB. Connect the wire to the N.O. terminal on the external self-test switch. Connect the common terminal of the switch to a BK/W wire (GND).)</i>
16	Y	LT COIN	Connect to the N.O. terminal of the left coin switch. Connect the common terminal of the switch to a BK/W wires.
17	W/BK	LT BUTTON 1	Connect this wire <i>or</i> the one at pin 22 to the N.O. terminals of the left button switches. Connect the common terminals of the switches to one of the BK/W wires.
18	W/BN	LT JOYST UP	Connect to the N.O. terminal of the switch. Connect the common terminal of the switch to one of the BK/W wires.
19	W/R	LT JOYST DN	Same as pin 18.
20	W/OR	LT JOYST LT	Same as pin 18.
21	W/Y	LT JOYST RT	Same as pin 18.
22	W/GN	LT BUTTON 2	Connect this wire <i>or</i> the one at pin 17 to the N.O. terminals of the left button switches. Connect the common terminals of the switches to one of the BK/W wires.
23	W/BU	Not used	
24	W/V	Not used	

Table 1-3 JAMMA Wire Connections, Continued

Pin	Wire Color	Signal	Instructions
25	W/GY	Not used	
26	V	Not used	
27	BK/W	GND	Connect one of the BK/W wires at pin 27, 28, e, and f to the negative sense terminal of the power supply (if it exists) and one to the common terminals of the coin switches. Connect two of these wires to the common terminals of the control switches on the control panel.
28	BK/W	GND	Same as pin 27.
<b>Solder Side</b>			
A	BN	GND	Connect to the 5V RTN (GND) terminal on the power supply. However, if you have 12V RTN, connect <i>one</i> of the BN wires at pin 1, 2, A, or B to the 12V RTN terminal.
B	BN	GND	Same as pin A.
C	R	+5V	Connect to the +5V terminal on the power supply. However, if your power supply has a +SENSE terminal, connect <i>one</i> of the R wires at pin 3, 4, C, or D to +SENSE instead of +5V.
D	R	+5V	Same as pin C.
E	OR	-5V	Connect to the -5V terminal of the power supply. If -5V is not available, connect to the 12V RTN or the 5-V RTN (GND) or leave it unconnected. <i>NOTE: If you do not have (or use) -5V, the maximum power to the speaker will be reduced by half.</i>
F	Y	+12V	Connect to the +12V terminal of the power supply.
H		<b>Key</b>	
J	V/W	COIN CTR 2	Connect this wire to one side of the second 12V coin counter. Clip R24 on the Klax PCB if you use a second coin counter. <i>Note: Do not use 24V counters.</i> If your counter requires 5V, connect a wire from the +5V terminal on the power supply. Also clip R24 on the game PCB.
K		Not used	
L	W	SPKR-	Connect to the - terminal on the speaker. (This wire is one of a twisted pair.)
M		Not used	
N	GN	GREEN	Attach to the video display.
P	BN	COMPSYNC	Attach to the video display.
R	GY	Service	
S		Not used	
T	OR	RT COIN	Connect to the N.O. terminal of the right coin switch. Connect the common terminal of the switch to a BK/W wire.
U	Y/BK	RT BUTTON 1	Connect this wire <i>or</i> the one at pin Z to the N.O. terminals of the right button switches. Connect the common terminals of the switches to one of the BK/W wires.
V	Y/BN	RT JOYST UP	Connect to the N.O. terminal of the switch. Connect the common terminal of the switch to one of the BK/W wires.
W	Y/R	RT JOYST DN	Same as pin V.
X	Y/OR	RT JOYST LT	Same as pin V.
Y	Y/W	RT JOYST RT	Same as pin V.
Z	Y/GN	RT BUTTON 2	Connect this wire <i>or</i> the one at pin U to the N.O. terminals of the right button switches. Connect the common terminals of the switches to one of the BK/W wires.
a	Y/BU	Not used	
b	Y/V	Not used	
c	Y/GY	Not used	
d	GY/W	Not used	
e	BK/W	GND	Connect one of the BK/W wires at pin 27, 28, e, or f to the negative sense terminal of the power supply (if it exists) and one to the common terminals of the coin switches. Connect two of these wires to the common terminals of the control switches on the control panel.
f	BK/W	GND	Same as pin e.



**Table 1-4 JAMMA Connector and Wires**

<i>Component Side</i>		<i>Solder Side</i>			
Signal	Wire Color	Pin	Wire Color	Signal	
GND	BN	1	A	BN	GND
GND	BN	2	B	BN	GND
+5V	R	3	C	R	+5V
+5V	R	4	D	R	+5V
-5V	OR	5	E	OR	-5V
+12V	Y	6	F	Y	+12V
<b>Key</b>		7	H		<b>Key</b>
COIN CTR 1	BU/W	8	J	V/W	COIN CTR 2
Not used		9	K		Not used
SPKR +	BN	10	L	W	SPKR -
Not used		11	M		Not used
RED	R	12	N	GN	GREEN
BLUE	BU	13	P	BN	COMPSYNC
VIDEO GND	BK	14	R	GY	SERVICE
SELF-TEST	W	15	S		Not used
<i>Left Player</i>				<i>Right Player</i>	
COIN 1	Y	16	T	OR	COIN 2
LT BUTTN 1	W/BK	17	U	Y/BK	RT BUTTN 1
LT JOY UP	W/BN	18	V	Y/BN	RT JOY UP
LT JOY DN	W/R	19	W	Y/R	RT JOY DN
LT JOY LT	W/OR	20	X	Y/OR	RT JOY LT
LT JOY RT	W/Y	21	Y	Y/W	RT JOY RT
LT BUTTN 2	W/GN	22	Z	Y/GN	RT BUTTN 2
Not used	W/BU	23	a	Y/BU	Not used
Not used	W/V	24	b	Y/V	Not used
Not used	W/GY	25	c	Y/GY	Not used
Not used	V	26	d	GY/W	Not used
GND	BK/W	27	e	BK/W	GND
GND	BK/W	28	f	BK/W	GND

crimp splices or butt soldering.

Also see Table 1-4, *JAMMA Connector and Wires*, for more information.

### **WARNING**

*Do not simply tie the wires together. If you do, you could cause intermittent problems, loose connections, oxidation, or a fire.*

### **Connecting Power Wires**

1. Connect the wires on the JAMMA harness to the wires for the power supply, as shown in Table 1-3. The Klax kit requires +5V and +12V. If -5V is available, it should be used too. Tie off any other voltage wires on the power supply besides +5V, -5V, and +12V.

There is more than one wire for each voltage in the JAMMA harness. Use more than one wire for each voltage (connecting them as described in Table 1-3) so that the edge connector does not overload and burn.

### **Connecting Video Display Wires**

#### **NOTE**

*The JAMMA harness provides only negative composite sync. If your video display requires separate positive sync, see Chapter 3 for alternative wiring.*

Connect the wires designated for the red, green and blue video guns along with the sync and ground wires, according to Table 1-3.

### **Connecting Coin Door Wires**

1. Connect the wires on the JAMMA harness to the coin switches and meter according to Table 1-3.
2. Connect one terminal of the door lamps to one of the BK/W wires. Connect the other terminal of the door lamps to the R wire supplying +5V.

#### **NOTE**

*Do not use -5V for the coin door lamps. -5V is required for audio.*

(Some games have separate power supply outputs for the coin door lamps. If you choose to use these outputs, make sure you connect both terminals of each lamp to the terminals on the power supply.)

### **Connecting the Control Wires**

Connect the joystick harnesses and the button harnesses to the JAMMA harness according to the information in Table 1-3.

### **Grounding the Cabinet**

Find the ground lead (green) of the 115V input power line. Connect this lead in daisy-chain fashion to a bare metal part of the coin door, the control panel, the video display, and the power supply. **This is required for the safety of the players.** This AC ground must be of #18 AWG wire or larger.

### **Checking the JAMMA Connections**

*Before* plugging in the game PCB, turn on the power to the game, and check +5 Volts on pins 3, 4, C, and D of the JAMMA connector; +12 Volts on pins F and 6; and -5 Volts on pins E and 5. Check that the video display and the attraction lamp have power.

Now turn off the power to the game.

## Installing the Klax Game PCB

1. After you have checked the power on the JAMMA connector, above, install the Klax game PCB in the cabinet. Use the nylon standoffs and four #6-32 screws in the kit.
2. Connect the JAMMA connector to the PCB.
3. Turn on the power to the game. Check that the game PCB functions. If a video picture is not present, see Chapter 3.

## Installing the Bezel, Labels, Decals, and Attraction Assembly

The kit parts are shown assembled in a cabinet in Figure 1-2.

### Installing the Display Bezel

Find the cardboard display bezel (part no. 047463-01). Measure the size of the existing display bezel and cut the new display bezel to size, if necessary.

### Installing the Product ID and FCC Label

Place the product ID label (part no. 038158-01) and FCC label (part no. 039450-01) on the back of the cabinet.

### Installing the Side Panel Decals

Find the side panel decals. Wet the left and right side panels of the cabinet with slightly soapy water. Then position the decals as shown in Figure 1-2. Remove any wrinkles in the artwork using a squeegee. Allow the sides to dry.

### Installing the Attraction Assembly

Find the Klax attraction shield and the attraction film. Using the existing shield as a template, cut the shield and film to size, if necessary. Install them on the cabinet as shown in Figure 1-2.

## Setting the Coin and Game Options

Set the coin and game options in the self-test. See Chapter 2 for information about the option settings.

## Game Play

This section of the manual describes the theme of the Klax game and the game play features.

### Introduction

The tiles klank end over end down the ramp. Catch them on the paddle, or they fall in the pit. Flip them from the paddle into the bins, matching the same-colored tiles horizontally, vertically, or diagonally. Each line of colored tiles is a Klax. When you've made a Klax, you hear a fanfare. When you complete a wave, the crowd cheers. Let a tile fall in the pit, and you hear a scream as it falls in. If you fail to complete a wave, the crowd is disappointed. Stay alive, complete the waves and don't drop any tiles!

### Game Play

Catch the tiles as they come to the end of the ramp on the paddle. Flip a tile into a bin by pressing the start/flip button. Pull the joystick forward to increase the speed of the closest tile as it klanks down the ramp. Push the joystick back and toss the top tile on the paddle back on the ramp and gain a little time.

The paddle can hold up to five tiles. As long as the green light is on below the paddle, you can pile more tiles on the paddle. When the red light appears, you must flip at least one tile in a bin or toss it back on the ramp before you can collect any more tiles. You can flip tiles into a bin as long as the green light is on below the bin.

To succeed in Klax, make points and also complete each wave. Create a horizontal, vertical, or diagonal row of at least three tiles (just like in tic-tac-toe) in the bins to make a Klax and make points. You receive the most points for diagonals, less for horizontals and the least for verticals. When you create a Klax, the tiles in the Klax disappear to make room for more tiles in the bins.

Each wave has a different task to be completed, which is shown on the To Go Meter. This task could be making a certain number of Klaxes or points or surviving a certain number of tiles. Complete the task before too many tiles drop in the pit and you complete the wave. When you complete a wave, you receive bonus points for the tiles remaining on the ramp, on the paddle, and any empty spaces in the bins. If you fail, you can start again at the same wave.

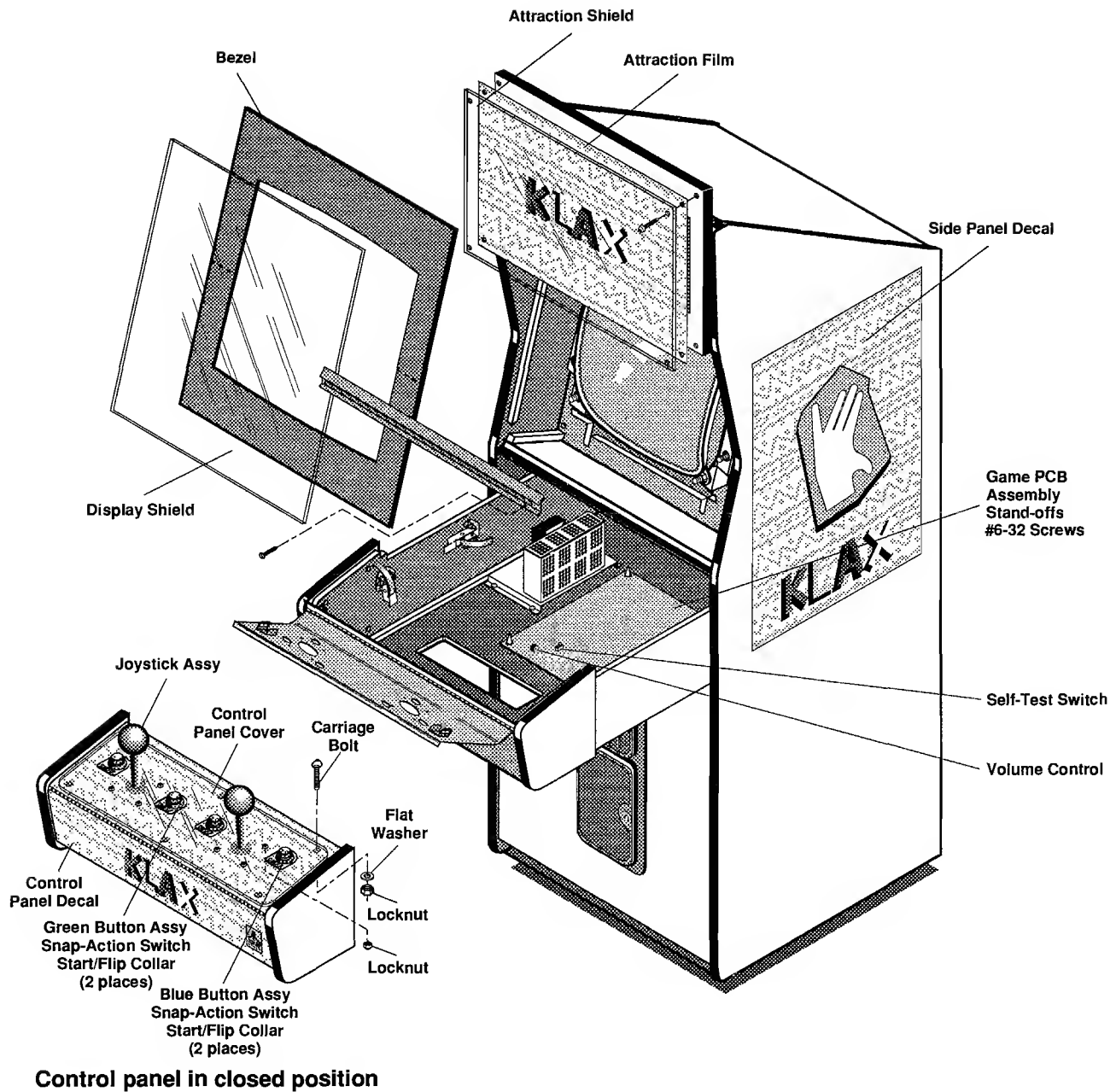
Klax does not have a clock for you to race against, but as your playing time increases, the tiles klank down the ramp faster and faster.

### Waves

When you first enter the game, you can start at wave 1, 6, or 11. Wave 1 teaches you how to play the game and use the controls. At every fifth wave you can choose to play the next wave, the fifth wave beyond, or the tenth wave beyond.

Klax has five different types of waves and more than five different backgrounds. There are five waves per level, and one hundred waves to complete.





**Figure 1-2 Klax Kit Parts Installed in a Cabinet**

Each time you begin a wave, the *To Go* meter shows what kind of Klaxes or how many points you need to accumulate to complete the wave. The different types of waves are:

*Klaxes To Go*, which are the easiest. Just create Klaxes horizontally, vertically or horizontally. Create enough Klaxes to complete the wave before the you drop too many tiles in the pit.

*Tiles To Go* requires you to survive a certain number of tiles. Create Klaxes in any of the three ways to collect points and to clear the bins to hold more tiles.

*Points To Go* requires you to make a certain number of points. Create Klaxes to collect points but make diagonals, four- or five-of-a-kind Klaxes, and simultaneous Klaxes for higher points.

*Diagonals To Go* requires you to create diagonals. Create Klaxes in any way to collect points; but only the correct number of diagonals will complete the wave.

*Horizontals To Go* requires you to create horizontals. Only horizontal Klaxes will complete the wave; but you can create Klaxes vertically and diagonally to collect points.

### **Game Meters**

You see several kinds of information on the screen. These are the:

*To Go Meter*, which continuously calculates the number of Klaxes, tiles, points, diagonals or horizontals still required to complete the wave. The number depends on the type of wave you are playing.

*Drop Count*, which shows the number of dropped tiles. The drop count is continuously calculated. When the number of tiles dropped is reached, the wave is over.

*High Score*, which shows the highest score to date, regardless of the number of continues that player had.

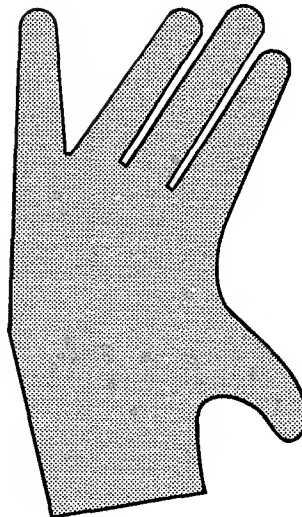
*Wave Indicator*, which shows what wave you are playing.

# N O T E S

## *Chapter 2*

# Self-Test

Use the Klax self-test to check the condition of the game circuitry and controls. You will see the self-test information on the video display and hear the sound test information through the speakers. You do not need any additional equipment to perform the self-test. Perform the self-test when you first set up the



game, each time you collect the money, or when you suspect game failure. This chapter shows the screens in the self-test and explains each of the tests. The screens and explanations are arranged in the order they appear in the self-test. Table 2-1 lists all the self-test screens and their purposes.

**Table 2-1 Summary of the Self-Test Screens**

Select Test Menu Screen
Statistics Screen
Histogram Screen 1
Histogram Screen 2
Game Options Screen
Coin Options Screen
Sound Test Screen
Switch Test Screen
RAM Test Screen
Playfield RAM (looping)
Motion Object RAM (looping)
Color RAM (looping)
All RAM (re-start)
ROM Test Screen
Alphanumeric Test Screen
Motion Object Screen
Color Test Screen
Red Color Purity Screen
Green Color Purity Screen
Blue Color Purity Screen
White Color Purity Screen
Grey Color Purity Screen
White Convergence Screen
Violet Convergence Screen
Green Convergence Screen

## Entering and Exiting the Self-Test

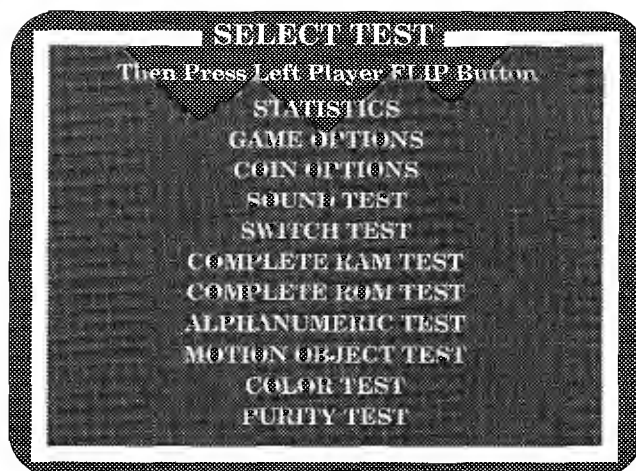
To enter the self-test, turn on the self-test switch on the game PCB. Exit the self-test by switching off the self-test switch *in the select test menu screen*. If you turn off the self-test switch while you are in any other screen, you will not exit until you return to the select test menu screen.

## Select Test Menu

Choose which test or screen you want to see from this menu, shown in Figure 2-1. Move up and down the menu using the left joystick. Choose the screen by pressing the left start/flip button.

## Statistics

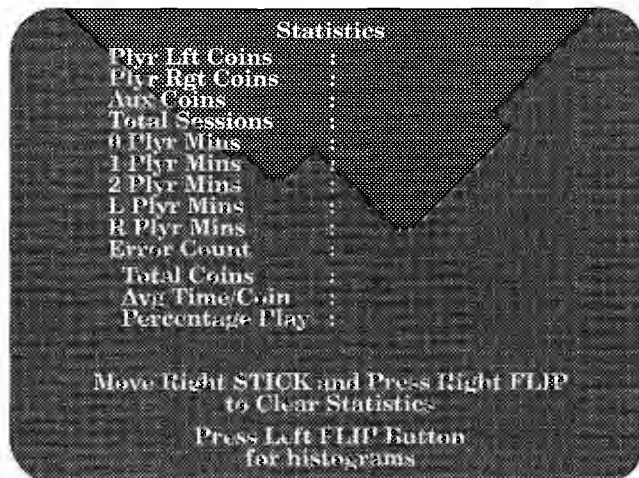
Use the information shown on the statistics screen, in Figure 2-2, and on the histogram screens to keep track of your game use and maximize your profits. Record the information on the Klax statistics page in the back of this manual.



**Figure 2-1 Select Test Menu Screen**

The statistics are collected from the last time the statistics were cleared. You can clear the statistics by moving the right joystick and pressing the right start/flip button at the same time. Press the left start/flip button to leave this screen and go to the histograms.

- *Plyr Lft Coins* show the number of coins counted in the left coin mechanism.
- *Plyr Rgt Coins* show the number of coins counted in the right coin mechanism.
- *Aux Coins* show the number of coins credits given by the auxiliary coin mechanism.
- *Total Sessions* shows the number of unique games played. A unique game is counted from the moment the first player started to the time the last player quit, regardless of how many times the game was continued.
- *0 Plyr Min* is the number of minutes the game was idle.



**Figure 2-2 Statistics Screen**



- *1 Plyr Min* is the number of minutes the game was played by one player.
- *2 Plyr Min* is the number of minutes the game was played by two players.
- *L Plyr Min* is the number of minutes the game was played by the left player.
- *R Plyr Min* is the number of minutes the game was played by the right player.
- *Error Count* shows the number of errors counted in the erasable memory. If you have an error count, the statistics may be wrong. If you consistently have errors counted for several weeks, replace the EEROM at 6E.
- *Total Coins* is the number of coins put into both coin mechanisms.
- *Avg Time/Coin* is the average amount of time, in seconds, each coin counted for.
- *Percentage Play* is the amount of time, as a percentage, that the game is played while it is turned on.

## Histograms

The two histogram screens show the length of game play. The first histogram screen is shown in Figure 2-3. Clear both histograms on the second screen.

Read the histogram screens frequently and record the numbers on the statistics sheet at the back of the manual. Read and clear the screens frequently. If more than 256 games are played in any one time category, then all the numbers on that screen are divided by two. If you read the screens infrequently, the number of games will always be correct proportionally, but may be incorrect numerically.

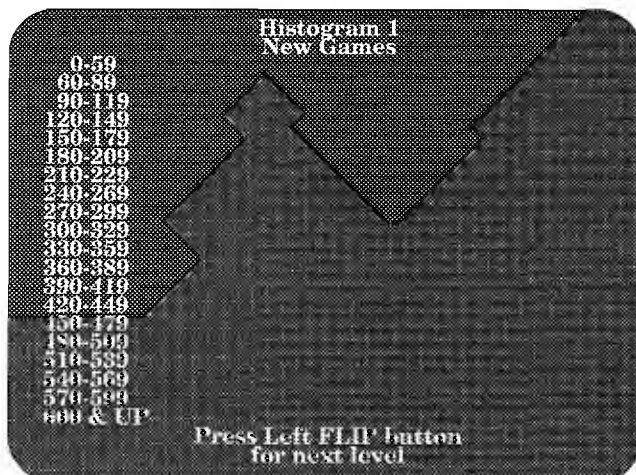


Figure 2-3 First Histogram Screen

Clear the histograms by pressing the right start/flip button when you are on the second histogram screen. Return to the menu screen by pressing the left start/flip button.

The two histogram screens show the following information:

- *New Games* shows the number of seconds each new game lasted.
- *Continuations* shows the number of seconds each continuation of the game lasted.

## Game Options

Check and select the game options on this screen, shown in Figure 2-4.

To move through the options, push the left joystick up or down. Change the option enclosed in the yellow box. The factory default settings are shown enclosed in a box. To change a setting, move the left joystick right or left. To save the new settings, press the left start/flip button. This returns you to the menu screen. If you want to keep the original setting, although you have changed it, move the right joystick and press the right start/flip button. This brings back the original setting. Use the left start/flip button to return to the menu screen.

### NOTE

*The word More appears at the bottom of the screen to indicate more options. Push the left joystick down to see the rest of the options.*

The game options are explained below. The settings, with defaults, are shown in Table 2-2.

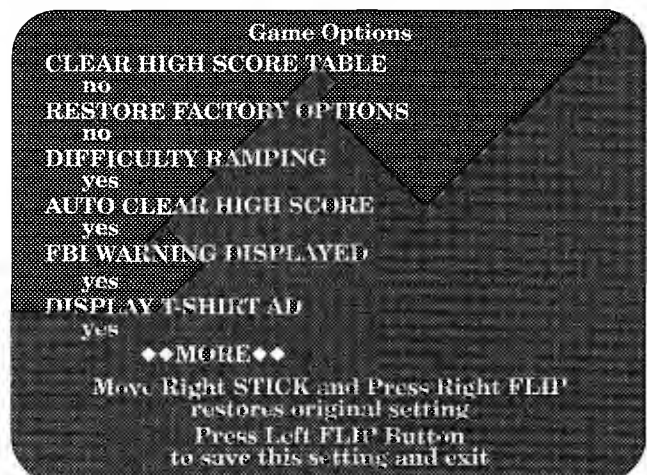


Figure 2-4 Game Options Screen

- *Clear High Score Table* lets you clear the high score table.
- *Restore Factory Options* lets you set all the game options to the factory options or lets you use your own settings. Make sure you set this to *no* to use your own chosen settings.
- *Difficulty Ramping* increases the game difficulty as the time after the last coin inserted increases if it is set to *yes*.
- *Auto Clear High Score* clears the high score table periodically if it is set to *yes*.
- *FBI Warning Displayed* lets you choose whether you want to display a “Winners Don’t Use Drugs” message and FBI logo screen during the attract mode.
- *Display T-Shirt Ad* lets you display the Klax T-shirt screen in the attract mode.
- *Sound in Attract Mode* lets you turn the sound on or off in the attract mode.
- *Difficulty Level* lets you set choose the difficulty level of the Klax game.
- *Special Cost* lets you choose two credits to start and one to continue, or no special cost.

Table 2-2 Game Option Settings

Option	Settings	
Clear High Score Table	Yes	No ♦
Restore Factory Options	Yes	No ♦
Difficulty Ramping	Yes ♦	No
Auto Clear High Score	Yes ♦	No
FBI Warning Displayed	Yes ♦	No
Display T-Shirt Ad	Yes ♦	No
Difficulty Level	Easy	Moderate ♦
	Hard	
Sound in Attract Mode	Yes ♦	No
Special Cost	2 credits to start, 1 credit to continue	
	No special cost ♦	
♦ <i>Manufacturer's recommended settings</i>		

Coin Options

Check and select the coin options on this screen, shown in Figure 2-5.

To move through the options, push the left joystick up or down. Change the option enclosed in the red box. The factory default settings are shown in green. To change a setting, move the left joystick right or left. To save the new settings, press the left start/flip button. This returns you to the menu screen. If you want to keep the original setting, although you have changed

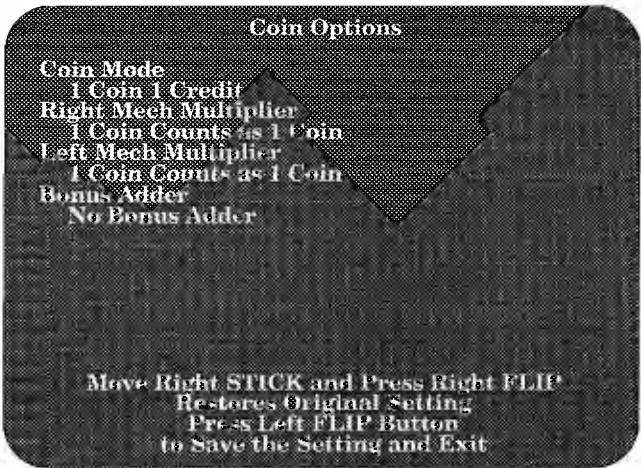


Figure 2-5 Coin Options Screen

it, move the right joystick and press the right start/flip button. This brings back the original setting. Use the left start/flip button to return to the menu screen.

The coin options are explained below. The settings, with defaults, are shown in Table 2-3.

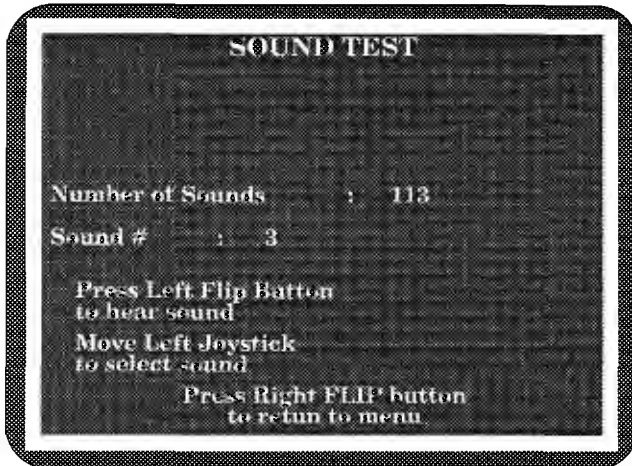
- *Coin Mode* is the number of coins required for one credit.
- *Right Mech Multiplier* is the number of coins each coin counts as in the right coin mechanism.
- *Left Mech Multiplier* is the number of coins each coin counts as in the left coin mechanism.
- *Bonus Adder* lets you choose bonus coins, no bonus, or free play.

Table 2-3 Coin Option Settings

Option	Settings
Coin Mode	1 coin 1 credit ♦ 2 coins 1 credit 3 coins 1 credit 4 coins 1 credit
Right Mech Multiplier	1 coin counts as 1 coin ♦ 4 coins count as 1 coin 5 coins count as 1 coin 6 coins count as 1 coin
Left Mech Multiplier	1 coin counts as 1 coin ♦ 1 coin counts as 2 coins
Bonus Adder	No Bonus Adder ♦ 2 coins give 1 extra coin 4 coins give 1 extra coin 4 coins give 2 extra coins 5 coins give 1 extra coin 3 coins give 1 extra coin Free Play (for demonstration mode)
♦ Manufacturer's recommended settings	

## Sound Test

The sound test indicates the condition of the sound effects circuit on the game PCB. The sound test screen appears in Figure 2-6.

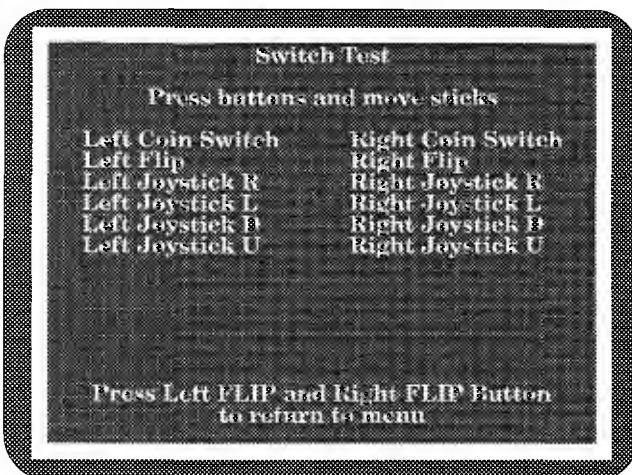


**Figure 2-6 Sound Test Screen**

Use the right joystick to select the sound and press the right start/flip button to listen to it. Pressing the left start/flip button returns you to the menu screen.

## Switch Test

The switch test screen is shown in Figure 2-7. Test the coin mechanisms, buttons, and joysticks. As you use the control, a red box appears around its name on the screen. If the red box does not appear, check the connections, switches, and mechanism. Press the left and right start/flip button to return to the menu screen.



**Figure 2-7 Switch Test Screen**

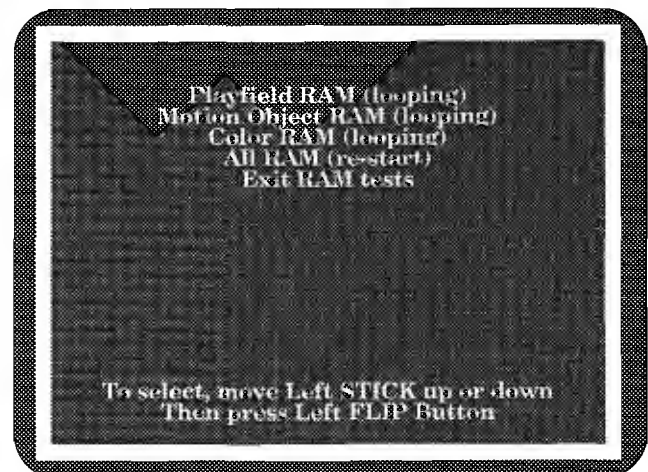
Pressing the left and right auxiliary coin switches tests the coin switches. Pressing either of the left start/flip buttons causes a box to appear around the words *Left Flip*. Pressing either of the right start/flip buttons causes a box to appear around the words *Right Flip*.

Moving the left joystick causes a box to appear around the direction name when you move it right (R), left (L), down (D), and up (U). Do the same for the right joystick. If a box does not appear around a joystick test direction, check the switch connections and the switch in that position.

## Complete RAM Test

Use this selection screen, shown in Figure 2-9, to choose which RAM test you want to perform. Use the different tests according to Table 2-4.

If you get an error in any of the RAM tests, see Table 2-5 for more information. If you have serious RAM problems you may see only a colored screen. If this happens, see Table 3-5.



**Figure 2-8 Complete RAM Test Screen**

**Table 2-4 When to Run the RAM Tests**

Problem	Type of Test	Location of RAMs Tested
Playfield is erratic or looks wrong.	Playfield RAM	2X, 2Y
Motion objects are erratic or not working properly.	Motion Object RAM	2X, 2Y
Colors look wrong.*	Color RAM	11J
Possible RAM problems.	All RAM	2X, 2Y, 11J

*\*If all you see are colored screens and you cannot run the self-test, you have serious RAM problems. See Table 3-5 for details.*

To choose a test, move the box to the test name and press the left start/flip button.

Return to the menu screen by moving the box to the words *Exit RAM Tests*, then press the left start/flip button to return to the menu screen.

**Table 2-5 Bad RAM Location by Error Address**

Error Address	RAM Location	
	High	Low
3F0000	2X	2Y
3E0000	11J	None

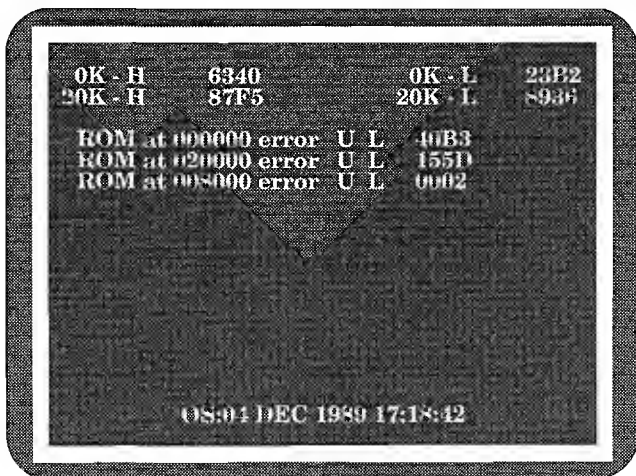
## Complete ROM Test

The ROM test screen is shown in Figure 2-9. The 0K and 20K information appears. If the game has no ROM errors, you immediately return to the menu screen.

If the game does have ROM errors, the ROM test screen will remain until the ROM error information is complete, as shown in Figure 2-9. Press the left start/flip button several times to see information about the ROM errors. The ROM error test takes a few seconds.

See Table 2-6 for the location of the ROM errors. Press the left start/flip button to return to the menu screen.

If you think you have a ROM error, but the screens show no messages, see Table 3-3 for information about the locations of various ROM functions.



**Figure 2-9 Complete ROM Test Screen**

**Table 2-6 Bad ROM Location by Error Address**

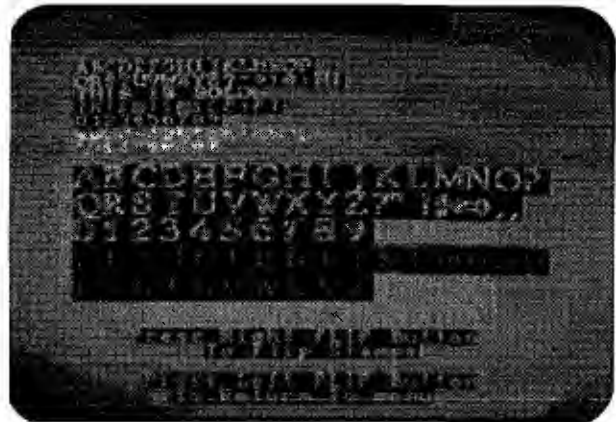
Error Address	RAM Location	
	High	Low
000000	3N	1N
020000	3K	1K

## Alphanumeric Test

The alphanumeric test, shown in Figure 2-10, checks the condition of the alphanumeric in the game. You can reverse the alphanumeric display by pressing the right start/flip button.

If you see an error on the screen, check the EPROMs at 12U, 12W, 12X, 12Y, 17U, 17W, 17X, and 17Y.

Press the left start/flip button to go to the menu screen.

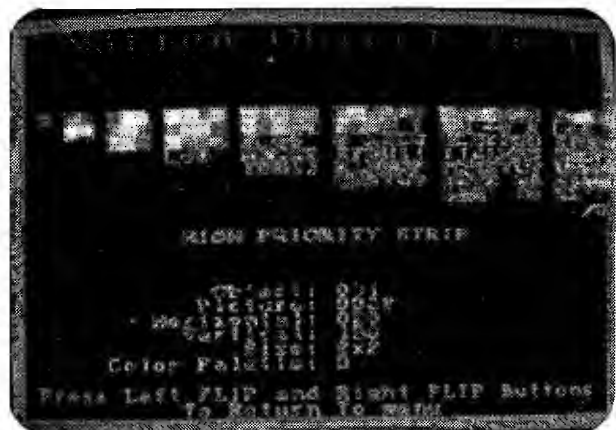


**Figure 2-10 Alphanumeric Test Screen**

## Motion Object Test

The motion object test screen, shown in Figure 2-11, tests the movement and color of various game objects.

Choose an object with the left start/flip button. Use the left joystick to move the object. Press the left and right start/flip buttons simultaneously to go to the menu screen.

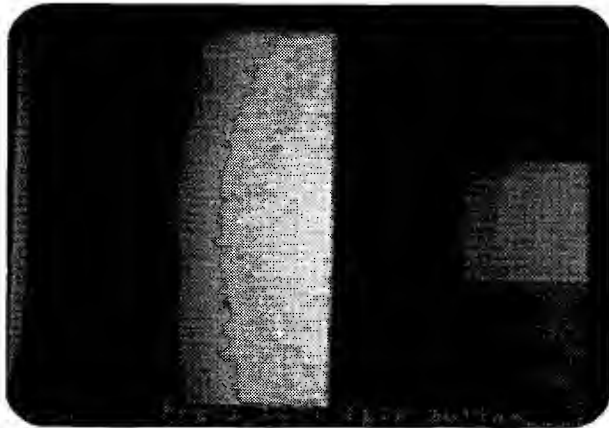


**Figure 2-11 Motion Object Test Screen**



## Color Test

This test indicates the dynamic range of the video display color circuit. The screen is shown in Figure 2-12.



**Figure 2- 12 Color Test Screen**

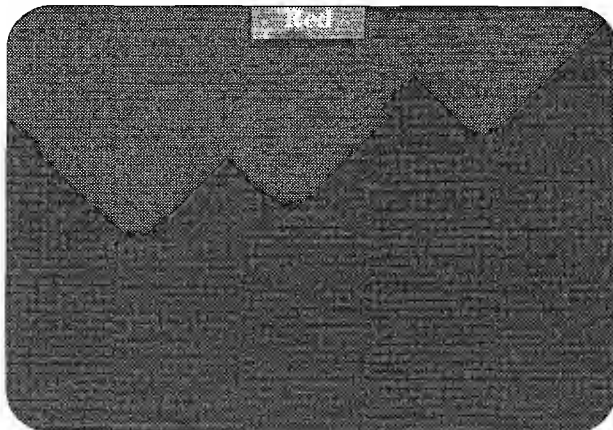
The left side of the screen shows a grey scale with black on the left and white on the right. The right half of the screen should be red, green, and blue from top to bottom, each with a color scale from dark to bright, left to right.

If the screen does not match this description, adjust the video display as described in the video display manual.

Return to the menu screen by pressing the left start/flip button.

## Color Purity Test

The color purity test has five screens. Each screen is a rectangle of color. The first screen, shown in Figure 2-13, is red. The other screens, which you can see by



**Figure 2-13 Color Purity Test Screen**

pressing the right start/flip button, are green, blue, white, and gray.

These screens show the adjustment of the color purity of the video display. Each screen should display a rectangle of color, with no curving at the corners, no unevenness of color, and no lines in the display.

If the screens are not correct, adjust the video display as described in the video display manual.

Return to the menu screen by pressing the left start/flip button.

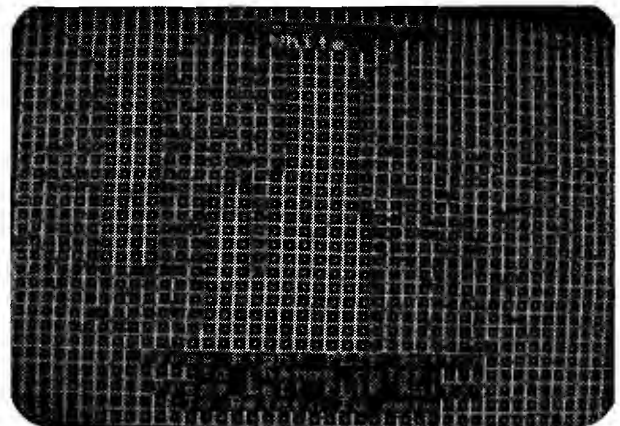
## Convergence Test

The convergence test has three screens: first white, then violet, and finally green. The white screen is shown in Figure 2-14. To see the violet and green screens, press the right start/flip button. Press the left start/flip to go to the menu screen.

Check the following on the screens:

- The grid lines should be straight within 3.0 mm and the lines should not pincushion or barrel.
- The convergence of the lines on the violet and white screens should be within 2.0 mm.

If these screens do not meet these criteria, adjust the video display as described in the video display manual.



**Figure 2- 14 Convergence Test Screen**

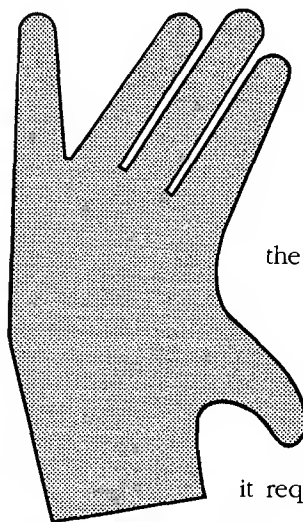


N O T E S

### *Chapter 3*

# Troubleshooting and Maintenance

This chapter contains troubleshooting tables and repair procedures for your Klax game. The chapter has two parts. The first part contains three troubleshooting tables. The first table has general troubleshooting information, the second table contains the voltage levels and test points on the game PCB, and



the last table describes ROM-caused problems with specific ROMs to check and replace. The last part of the chapter has information about connecting the video display if it requires separate positive sync, repair information for the joystick assembly and locations of the RAMs and ROMs on the game PCB.

**Table 3-1 Troubleshooting Table**

<b>Problem</b>	<b>Suggested Action</b>
<b>Coin Mechanism Problem</b>	<ol style="list-style-type: none"> <li>1. Check the wiring to the coin mechanism.</li> <li>2. Check the voltage to the + side of the mechanism.</li> <li>3. Test the coin mechanisms with the sound test screen in the self-test.</li> </ol>
<b>Game Play Problem</b>	<ol style="list-style-type: none"> <li>1. Check the harness and connectors.</li> <li>2. Perform the self-test.</li> <li>3. Check the voltage levels on the PCB. See Table 3-2, <i>Voltage Inputs and Test Points</i>.</li> <li>4. Check <i>What ROM Problems Look Like</i>, Table 3-3, for specific ROM problems. See Figure 3-1 for ROM locations.</li> </ol>
<b>Joystick Problem</b>	<ol style="list-style-type: none"> <li>1. Has the joystick been lubricated with white lithium grease? If not, lubricate.</li> <li>2. Check the harness and connectors.</li> <li>3. Check the switches on the joystick.</li> <li>4. If you took the joystick apart, have you reassembled it correctly?</li> <li>5. Make sure all the parts on the joystick are in good repair. Repair or replace parts.</li> </ol>
<b>Sound Problem</b>	<ol style="list-style-type: none"> <li>1. Is the speaker volume turned up?</li> <li>2. Check the voltage on the JAMMA connector.</li> <li>3. Check the wiring from the PCB to the speaker.</li> <li>4. Check the voltage level to the PCB. See Table 3-2, <i>Voltage Inputs and Test Points</i>.</li> <li>5. Replace the speaker.</li> </ol>
<b>Video Display Problem</b>	
Sync problems.	Does your display need separate positive sync? See the <i>Video Display Sync Problems</i> section in this chapter.
Screen is dark.	<ol style="list-style-type: none"> <li>1. Is the game plugged in?</li> <li>2. Is the game turned on?</li> <li>3. Are the connections good?</li> <li>4. Is the line fuse good?</li> <li>5. Is the display brightness turned up?</li> <li>6. Are the solder connections on the line filter and transformer good?</li> <li>7. Is the JAMMA connector on the PCB tightly connected?</li> <li>8. Check all of the items below. If you answer <i>no</i> to any question, you have a problem with the video display, not with the game circuitry. See your video display service manual. <ol style="list-style-type: none"> <li>a. Do you have power to the video display?</li> <li>b. Are the video display's filaments lit?</li> <li>c. Do you have high voltage to the video display?</li> </ol> </li> <li>9. Is the voltage level to the video display PCB correct? (Power voltage is 100 VAC or 110 VAC, depending on the type of video display. Video signal voltage is 0.5 to 3.5 Volts.)</li> <li>10. If the level is not correct, check the connectors and the harness.</li> </ol>
Only a colored screen appears.	You probably have a serious RAM problem. See Table 3-5, <i>Colored Screens Indicating Bad RAMs</i> .
Display area wavers or is too small.	<ol style="list-style-type: none"> <li>1. Do you have voltage to the video display PCB?</li> <li>2. Do you have high voltage to the video display?</li> </ol>
Picture is wavy.	<ol style="list-style-type: none"> <li>1. Is the monitor ground connected to the monitor?</li> <li>2. Are the sync inputs connected properly? Does your monitor need a separate positive sync? See the <i>Video Display Sync Problems</i> section in this chapter.</li> </ol>
Picture is upside down.	Switch the horizontal or vertical yoke wires on the display.
Convergence, purity or color problems.	Use the screens in the self-test to adjust the video display.
Picture is not centered.	Use the centering procedures in your video display manual. If that does not center it, read the section <i>Horizontal Shifting</i> , on page 3-3.

**Table 3-2 Voltage Inputs and Test Points on the PCB**

Voltage	Test Point or LED	Source and Purpose
+5 $\pm$ 0.25 VDC	+5V1	Logic power from the switching power supply.
	CR7 LED	Lights when 5 V is applied to the PCB and the reset (RST) jumper is open.
	CR4 LED	Lights when the +12 V supply is good.
	CR3 LED	Lights when the -5 V supply is good.
+12V	+V0P (pin 4 of LM324)	+12 V from the switching power supply. Positive supply for the analog circuitry.
-5V	-V0P (pin 11 of LM324)	-5V from the switching power supply (if connected). Negative supply for the analog circuitry.

**Table 3-3 What ROM Problems Look Like**

Problem	ROM Causing the Problem	Check the ROM at:
Program works but the motion objects or playfield are wrong.	Graphics	12U, 12W, 12X, 12Y 17U, 17W, 17X, 17Y
Garbage on screen; program doesn't work.	Processor	5C
Game program is erratic. No sound or erratic sound.	Program ROM 0	1N, 3N
	Program ROM 1, 2	1K, 3K, 1E, 3E
	Audio ROM	12B, 14B

## Video Display

### Sync Problems

Some video displays cannot use the composite negative sync that is on the JAMMA connector. The Klax kit includes a standard Atari Games video connector (located at 12A) that provides separate positive sync. Refer to Table 3-4 and make the appropriate connections for your video display.

For other problems, see the video display manual that came with your game.

**Table 3-4 Atari Games Video Connector Pin Assignments**

Pin	Signal
1	Red
2	GND
3	Key
4	Green
5	GND
6	Blue
7	GND
8	GND
9	Negative composite sync
10	Positive V sync

### Horizontal Shifting

If you cannot center the picture on the display horizontally as described in your video display manual, you can shift it by altering the Klax game PCB.

1. Remove the resistor at R102.
2. To shift the display to the right, add a resistor of less than 100 $\Omega$  (or a wire) at location R105.
3. To shift the display to the left,, add a resistor of less than 100 $\Omega$  (or a wire) at location R103.

## Joystick Assembly

The joystick is shown in Figure 3-2. If you want to repair the joystick, disassemble it by removing the E-ring at the bottom of the shaft and removing the screws.

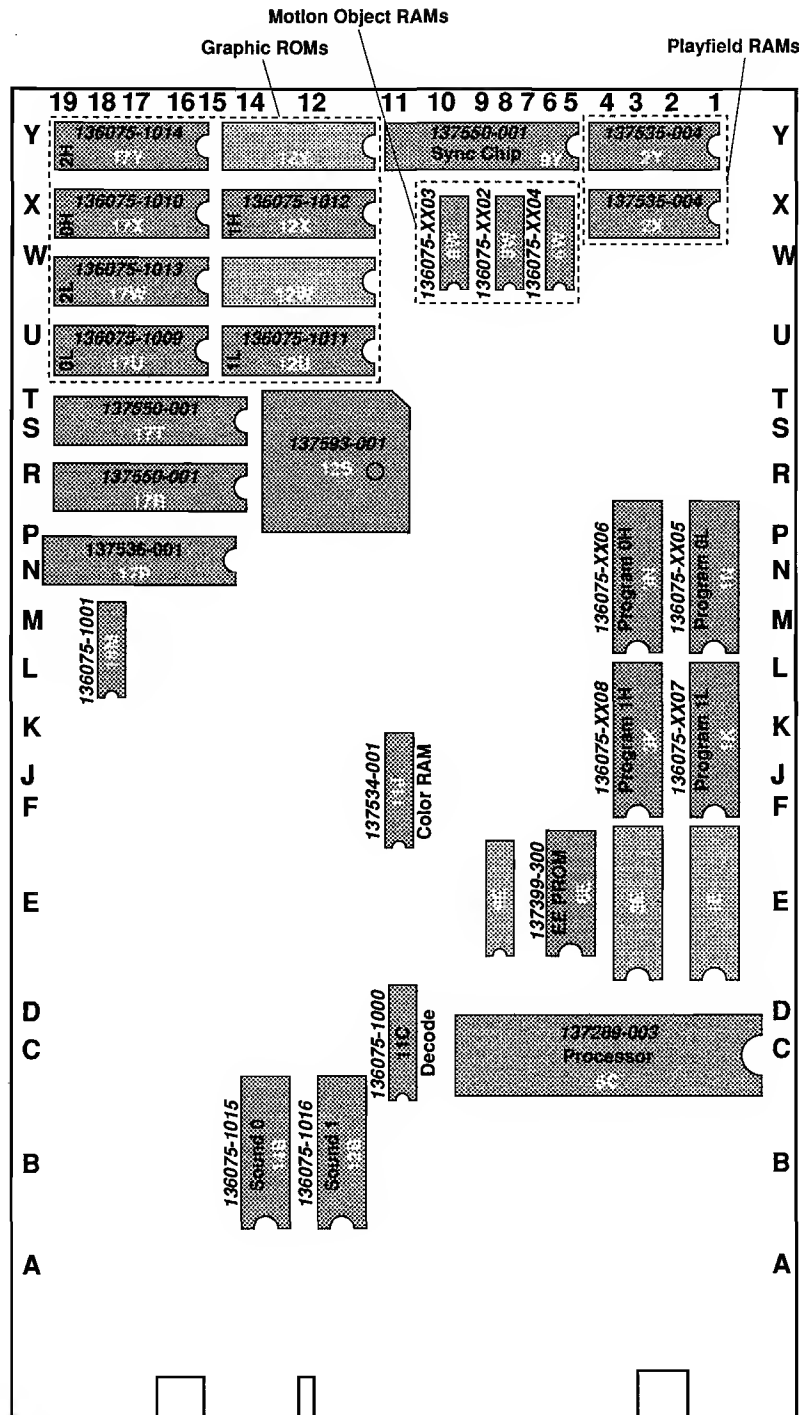
**Table 3-5 Screen Colors Indicating Bad RAMs**

Screen Color	RAM Error Location
Red	Working RAM
Green	Playfield RAM
Blue	Motion Object RAM

## ROMs and RAMs

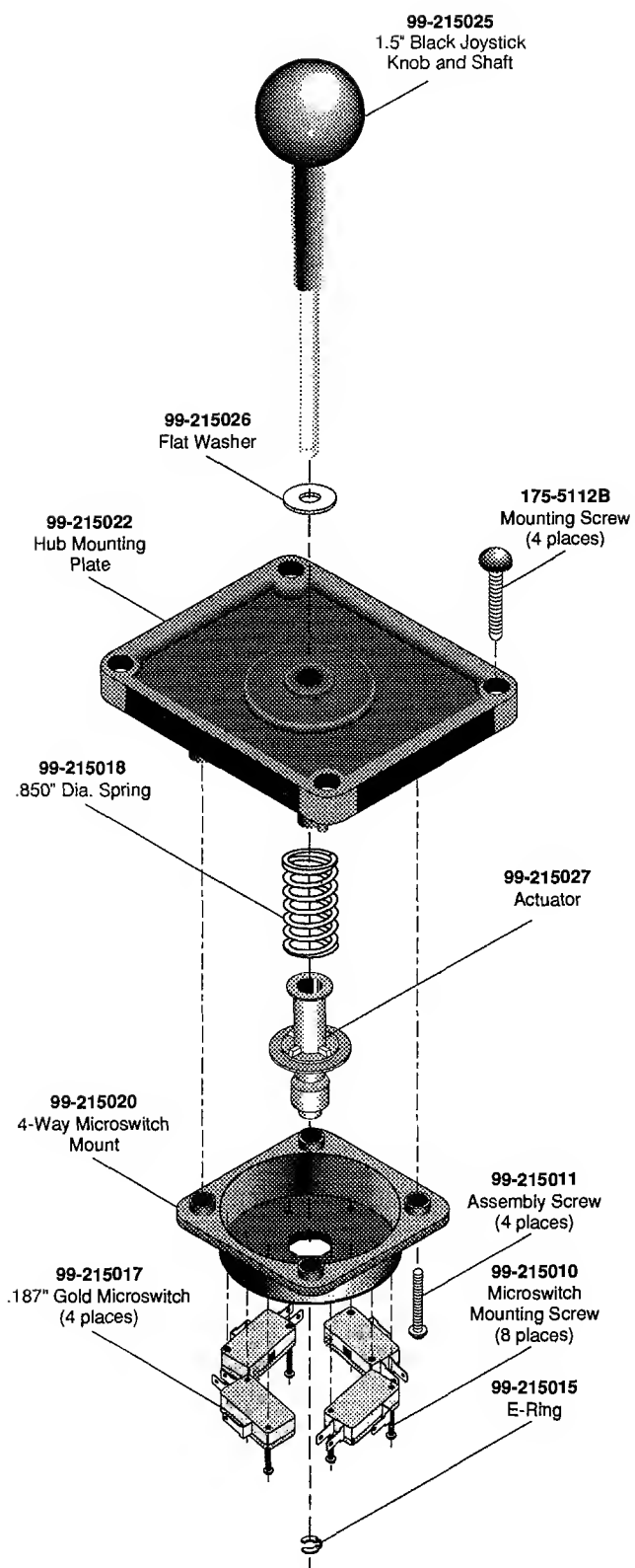
If you have think you have bad ROMs or RAMs, perform the ROM or RAM test in the self-test. If you see

only a colored screen and cannot enter the self-test, see Table 3-4. If you have a ROM problem, see Table 3-3. For the location of all the ROMs and RAMs on the game PCB, see Figure 3-1.



### Figure 3-1 RAM and ROM Locations on the Klax Game PCB



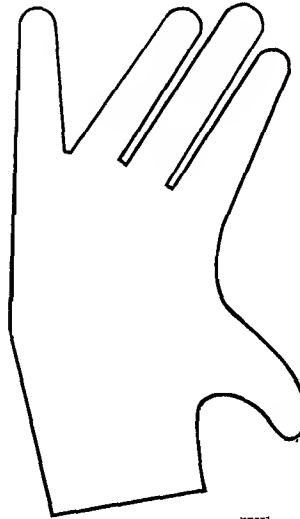


**Figure 3-2 Maintaining the Joystick Assembly**

# N O T E S

## *Chapter 4*

# Illustrated Parts Lists



This chapter provides information you need to order parts for your game. Common hardware parts, such as screws, nuts, washers, and so on usually are not listed in the parts lists. The parts lists (except

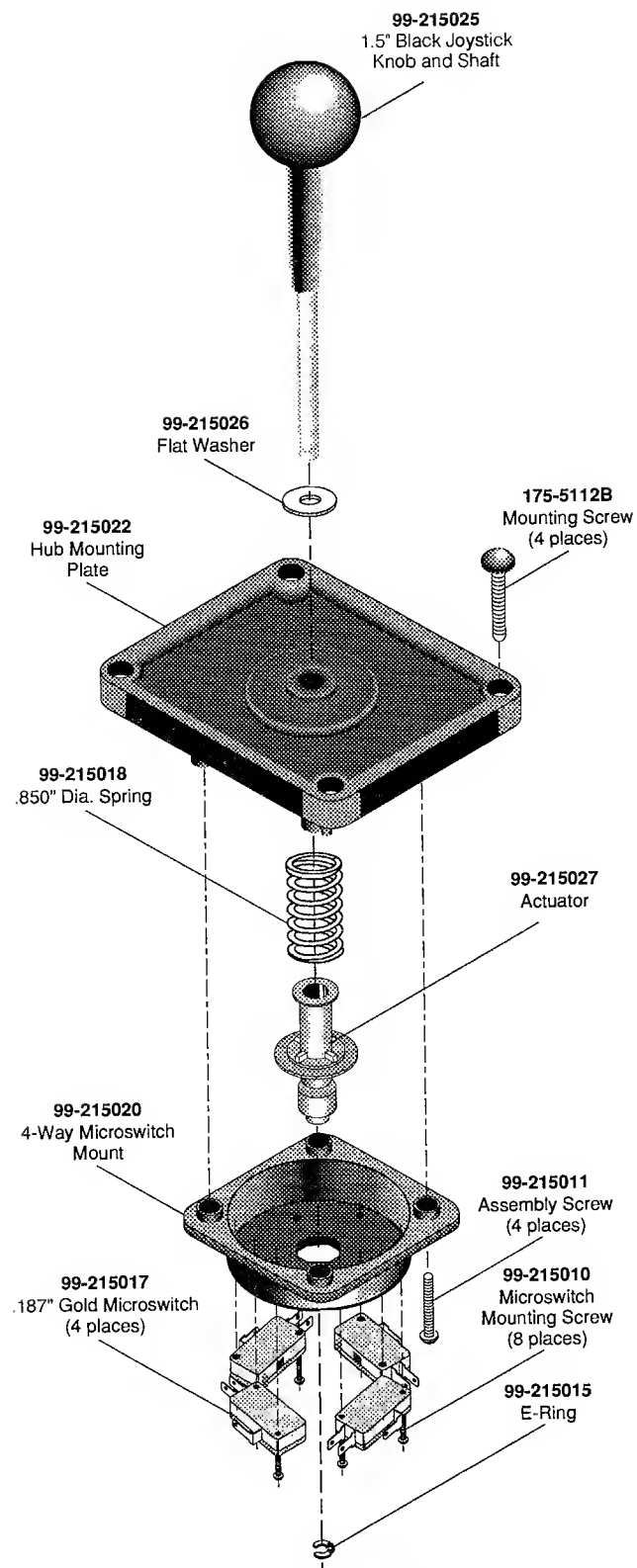
for the PCB parts lists) are arranged alphanumerically by Atari part number. All A-prefix numbers, which are assemblies, come first. Next are part numbers with six numbers followed by a hyphen (000598- through 201000-). Ending the list are part numbers with a two-number designation followed by a hyphen (00-

through 99-). The PCB parts lists are arranged in alphabetical order by component. Within each section the parts are arranged numerically by part number.

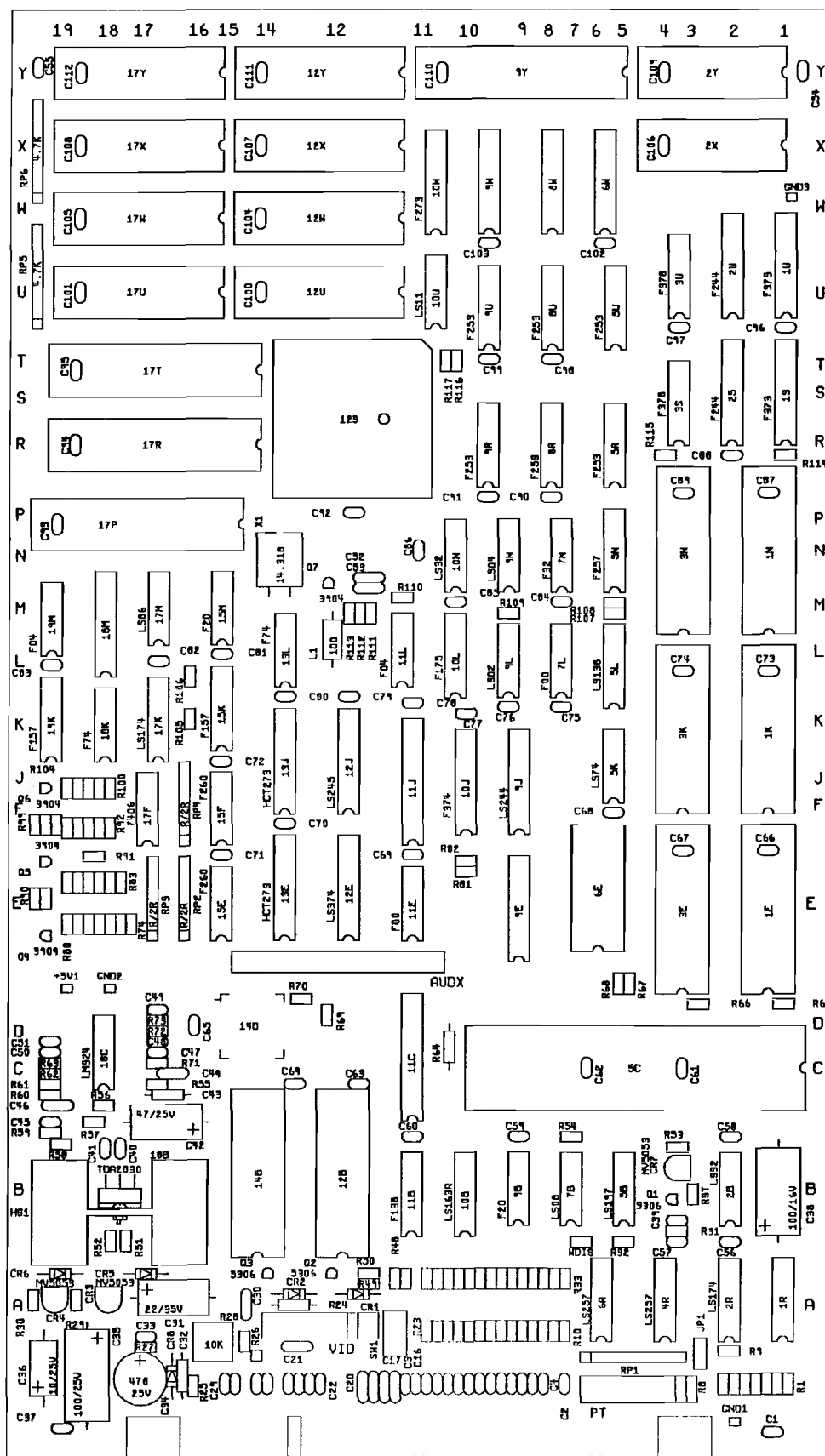
When you order parts, give the part number, part name, the number of this manual, and the serial number of your game. With this information, we can fill your order rapidly and correctly. We hope this will create less downtime and more profit from your games. Atari Games Customer Service phone numbers are listed on the inside front cover of this manual.

**Figure 4-1 Klax Kit Parts List**  
**A047620-01 C**

<b>Part No.</b>	<b>Description</b>	<b>Part No.</b>	<b>Description</b>
A046501-01	JAMMA Harness Assy	171057-003	4-Way Joystick Assy
A047441-01	Klax Game PCB Assy	175014-1040	#10 Flat Washer
038158-01	Product I.D. Label	177010-240	#10-24 Hex Polymer Locknut
039450-01	FCC Compliance Label	178032-002	Wire Wrap
047205-01	Attraction Shield	178237-005	Blue Button Assy
047209-01	Control Panel Cover	178237-006	Green Button Assy
047590-01	Control Panel Decal	178265-001	L-Style Nylon Standoff
047594-01	Side Panel Decal	178283-002	Orange Start/Flip Button Collar
047595-01	Attraction Film With Graphics	72-6612S	#6 x 3/4-Inch-Long Pan-Head Screw
047621-01	Bezel With Graphics	75-5112B	#10-24 x 3/4-Inch-Long Black Carriage Bolt
141026-001	Split Ferrite Bead	TM-348	Klax Universal Kit Installation Instructions
160044-001	Snap-Action Switch		



**Figure 4-2 Joystick Assembly**  
**171057-003**



### Figure 4-3 Klax Game PCB Assembly

**A047441-01 D**

(For location of RAMs and ROMs, see Figure 3-1.)



### Klax Game PCB Parts List A047441-01 D

Designation	Description	Part No.	Designation	Description	Part No.
<b>Integrated Circuits</b>			12J	Integrated Circuit, 74LS245	137134-001
1K	Integrated Circuit, EPROM	136075-1007	12S	Integrated Circuit, MOB	137593-001
1N	Integrated Circuit, EPROM	136075-1005	12U	Integrated Circuit, EPROM	136075-1011
1S, 1U	Integrated Circuit, 74F373	137575-001	12X	Integrated Circuit, EPROM	136075-1012
2A	Integrated Circuit, 74LS174	137122-001	13E, 13J	Integrated Circuit, 74HCT273	137655-001
2B	Integrated Circuit, 74LS32	137019-001	13L	Integrated Circuit, 74F74	137436-001
2S, 2U	Integrated Circuit, 74F244	137502-001	14B	Integrated Circuit, OTP	136075-1015
2X, 2Y	Integrated Circuit, RAM, 8KX8, 100 nsec	137535-004	15E, 15F	Integrated Circuit, 74F260	137570-001
3K	Integrated Circuit, EPROM	136075-1008	15K	Integrated Circuit, 74F157	137494-001
3N	Integrated Circuit, EPROM	136075-1006	15M	Integrated Circuit, 74F20	137530-001
3S, 3U	Integrated Circuit, 74F378	137612-001	17F	Integrated Circuit, 7406	137052-001
4A	Integrated Circuit, 74LS257	137136-001	17K	Integrated Circuit, 74LS174	137122-001
5B	Integrated Circuit, 74LS197	137240-001	17M	Integrated Circuit, 74LS86	137079-001
5C	Integrated Circuit, 68000	137289-003	17P	Integrated Circuit, LB	137536-001
5K	Integrated Circuit, 74LS74	137023-001	17R, 17T	Integrated Circuit, SOS	137550-001
5L	Integrated Circuit, 74LS138	137177-001	17U	Integrated Circuit, EPROM	136075-1009
5N	Integrated Circuit, 74F257	137611-001	17W	Integrated Circuit, EPROM	136075-1013
5R, 5U	Integrated Circuit, 74F253	137574-001	17X	Integrated Circuit, EPROM	136075-1010
6A	Integrated Circuit, 74LS257	137136-001	17Y	Integrated Circuit, EPROM	136075-1014
6E	Integrated Circuit, EEPROM	137399-300	18B	Integrated Circuit, TDA2030	137301-001
6W	Integrated Circuit, GAL16V8 A	136075-1004	18C	Integrated Circuit, LM324	137582-001
7B	Integrated Circuit, 74LS08	137012-001	18K	Integrated Circuit, 74F74	137436-001
7L	Integrated Circuit, 74F00	137327-001	18M	Integrated Circuit, GAL16V8 A	136075-1001
7N	Integrated Circuit, 74F32	137486-001	19K	Integrated Circuit, 74F157	137494-001
8R, 8U	Integrated Circuit, 74F253	137574-001	19M	Integrated Circuit, 74F04	137437-001
8W	Integrated Circuit, GAL16V8 A	136075-1002	<b>Capacitors</b>		
9B	Integrated Circuit, 74F20	137530-001	C2-C16	Capacitor, .1 $\mu$ F, 50 V, Ceramic	122002-104
9J	Integrated Circuit, 74LS244	137038-001	C17	Capacitor, .001 $\mu$ F, 50 V, Ceramic	122002-102
9L	Integrated Circuit, 74LS02	137042-001	C18-C20	Capacitor, 100 pF, 100 V, Ceramic	122016-101
9N	Integrated Circuit, 74LS04	137009-001	C21	Capacitor, .001 $\mu$ F, 50 V, Ceramic	122002-102
9R, 9U	Integrated Circuit, 74F253	137574-001	C22-C29	Capacitor, .1 $\mu$ F, 50 V, Ceramic	122002-104
9W	Integrated Circuit, GAL16V8 A	136075-1003	C30	Capacitor, .001 $\mu$ F, 50 V, Ceramic	122002-102
9Y	Integrated Circuit, SOS	137550-001	C31	Capacitor, 22 $\mu$ F, 35 V, Electrolytic	124000-226
10B	Integrated Circuit, 74LS163 A	137114-001	C32	Capacitor, .22 $\mu$ F, 50 V, Ceramic	122017-224
10J	Integrated Circuit, 74F374	137420-001	C33	Capacitor, .1 $\mu$ F, 50 V, Ceramic	122002-104
10L	Integrated Circuit, 74F175	137498-001	C34	Capacitor, 470 $\mu$ F, 25 V, Electrolytic, Radial	123003-477
10N	Integrated Circuit, 74LS32	137019-001	C35	Capacitor, 100 $\mu$ F, 25 V, Electrolytic	124009-107
10U	Integrated Circuit, 74LS11	137149-001	C36	Capacitor, 10 $\mu$ F, 25 V, Electrolytic	124009-106
10W	Integrated Circuit, 74F273	137610-001	C38	Capacitor, 100 $\mu$ F, 16 V, Electrolytic	124008-107
11B	Integrated Circuit, 74F138	137521-001	C39-C41	Capacitor, .1 $\mu$ F, 50 V, Ceramic	122002-104
11C	Integrated Circuit, GAL16V8 A	136075-1000	C42	Capacitor, 47 $\mu$ F, 25 V, Electrolytic	124009-476
11E	Integrated Circuit, 74F00	137327-001	C43	Capacitor, .0068 $\mu$ F, 50 V, Ceramic	122015-682
11J	Integrated Circuit, RAM, 2KX8, 35 nsec	137534-001	C44	Capacitor, 270 pF, 100 V, Ceramic	122016-271
11L	Integrated Circuit, 74F04	137437-001	C45	Capacitor, .1 $\mu$ F, 50 V, Ceramic	122002-104
12E	Integrated Circuit, 74LS374	137144-001	C46	Capacitor, 270 pF, 100 V, Ceramic	122016-271

## Klax Game PCB Parts List, Continued

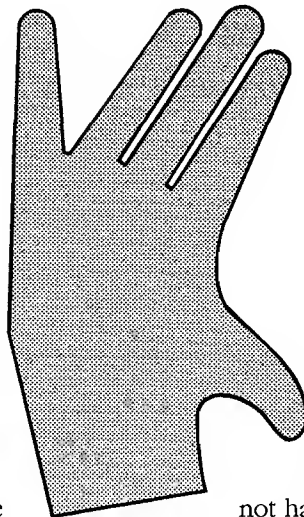
### A047441-01 D

Designation	Description	Part No.	Designation	Description	Part No.
C47	Capacitor, .1 $\mu$ F, 50 V, Ceramic	122002-104	R67, R68	Resistor, 1 K $\Omega$ , $\pm$ 5%, 1/8 W	110027-102
C48	Capacitor, 180 pF, 100 V, Ceramic	122016-181	R70	Resistor, 10 $\Omega$ , $\pm$ 5%, 1/8 W	110027-100
C49, C50	Capacitor, .1 $\mu$ F, 50 V, Ceramic	122002-104	R71	Resistor, 20 K $\Omega$ , $\pm$ 5%, 1/8 W	110027-203
C51	Capacitor, .033 $\mu$ F, 50 V, Ceramic	120015-333	R72, R73	Resistor, 1 M $\Omega$ , $\pm$ 5%, 1/8 W	110027-105
C52	Capacitor, 100 pF, 100 V, Ceramic	122016-101	R74, R75	Resistor, 470 $\Omega$ , $\pm$ 5%, 1/8 W	110027-471
C53	Capacitor, 39 pF, 100 V, Ceramic	122016-390	R76	Resistor, 1 K $\Omega$ , $\pm$ 5%, 1/8 W	110027-102
C56-C112	Capacitor, .1 $\mu$ F, 50 V, Ceramic	122002-104	R78	Resistor, 2.2 K $\Omega$ , $\pm$ 5%, 1/8 W	110027-222
<b>Diodes</b>			R79	Resistor, 4.3 K $\Omega$ , $\pm$ 5%, 1/8 W	110027-432
CR1, CR2	Diode, 1N4001	131048-001	R81, R82	Resistor, 1 K $\Omega$ , $\pm$ 5%, 1/8 W	110027-102
CR3, CR4	Diode, MV5053, Light Emitting	131027-002	R83	Resistor, 470 $\Omega$ , $\pm$ 5%, 1/8 W	110027-471
CR5, CR6	Diode, 1N4001	131048-001	R84	Resistor, 1 K $\Omega$ , $\pm$ 5%, 1/8 W	110027-102
CR7	Diode, MV5053, Light Emitting	131027-002	R86	Resistor, 2.2 K $\Omega$ , $\pm$ 5%, 1/8 W	110027-222
CR8	Diode, 1N4001	131048-001	R87	Resistor, 4.3 K $\Omega$ , $\pm$ 5%, 1/8 W	110027-432
<b>Inductor</b>			R89	Resistor, 10 $\Omega$ , $\pm$ 5%, 1/8 W	110027-100
L1	Inductor, 100 $\mu$ H	141024-001	R90	Resistor, 100 $\Omega$ , $\pm$ 5%, 1/8 W	110027-101
<b>Transistors</b>			R91	Resistor, 10 $\Omega$ , $\pm$ 5%, 1/8 W	110027-100
Q1-Q3	Transistor, 2N5306	133033-001	R92	Resistor, 1 K $\Omega$ , $\pm$ 5%, 1/8 W	110027-102
Q4-Q7	Transistor, 2N3904	133041-001	R94	Resistor, 2.2 K $\Omega$ , $\pm$ 5%, 1/8 W	110027-222
<b>Resistors</b>			R95	Resistor, 4.3 K $\Omega$ , $\pm$ 5%, 1/8 W	110027-432
R10, R11	Resistor, 470 $\Omega$ , $\pm$ 5%, 1/8 W	110027-471	R97, R98	Resistor, 100 $\Omega$ , $\pm$ 5%, 1/8 W	110027-101
R12	Resistor, 1 K $\Omega$ , $\pm$ 5%, 1/8 W	110027-102	R99, R102	Resistor, 10 $\Omega$ , $\pm$ 5%, 1/8 W	110027-100
R13-R17	Resistor, 470 $\Omega$ , $\pm$ 5%, 1/8 W	110027-471	R108	Resistor, 10 $\Omega$ , $\pm$ 5%, 1/8 W	110027-100
R18-R21	Resistor, 1 K $\Omega$ , $\pm$ 5%, 1/8 W	110027-102	R109	Resistor, 1 K $\Omega$ , $\pm$ 5%, 1/8 W	110027-102
R22, R23	Resistor, 470 $\Omega$ , $\pm$ 5%, 1/8 W	110027-471	R110	Resistor, 68 $\Omega$ , $\pm$ 5%, 1/8 W	110027-680
R24	Resistor, 0 $\Omega$ , $\pm$ 5%, 1/4 W	110005-001	R111, R112	Resistor, 10 K $\Omega$ , $\pm$ 5%, 1/8 W	110027-103
R25	Resistor, 15 K $\Omega$ , $\pm$ 5%, 1/8 W	110027-153	R113	Resistor, 240 $\Omega$ , $\pm$ 5%, 1/8 W	110027-241
R26	Resistor, 1.5 K $\Omega$ , $\pm$ 5%, 1/8 W	110027-152	R114, R115	Resistor, 10 $\Omega$ , $\pm$ 5%, 1/8 W	110027-100
R27	Resistor, 220 $\Omega$ , $\pm$ 5%, 1/8 W	110027-221	R116, R117	Resistor, 1 K $\Omega$ , $\pm$ 5%, 1/8 W	110027-102
R28	Potentiometer, 10 K $\Omega$ , Vert, With Knob	119020-103	RP2-RP4	Resistor, R/2R	118016-001
R29, R30	Resistor, 1 K $\Omega$ , $\pm$ 5%, 1/8 W	110027-102	RP5, RP6	Resistor, 4.7 K $\times$ 9, $\pm$ 5%, 1/8 W, SIP (10 Pin)	118010-472
R31	Resistor, 240 $\Omega$ , $\pm$ 5%, 1/8 W	110027-241	<b>Crystal</b>		
R32-R34	Resistor, 1 K $\Omega$ , $\pm$ 5%, 1/8 W	110027-102	X1	Crystal, 14.318	144000-004
R35	Resistor, 470 $\Omega$ , $\pm$ 5%, 1/8 W	110027-471	<b>Sockets</b>		
R36-R40	Resistor, 1 K $\Omega$ , $\pm$ 5%, 1/8 W	110027-102		Socket, 20 Pin, .300"	179259-020
R41-R44	Resistor, 470 $\Omega$ , $\pm$ 5%, 1/8 W	110027-471		Socket, 24 Pin, .300"	179259-024
R45-R51	Resistor, 1 K $\Omega$ , $\pm$ 5%, 1/8 W	110027-102		Socket, 28 Pin, .600"	179257-028
R52	Resistor, 20 K $\Omega$ , $\pm$ 5%, 1/8 W	110027-203		Socket, 32 Pin, .600"	179257-032
R53	Resistor, 100 K $\Omega$ , $\pm$ 5%, 1/8 W	110027-104		Socket, 40 Pin, .600"	179257-040
R54	Resistor, 1 K $\Omega$ , $\pm$ 5%, 1/8 W	110027-102		Socket, 64 Pin, .900"	179256-064
R55, R56	Resistor, 20 K $\Omega$ , $\pm$ 5%, 1/8 W	110027-203		Socket, 84 Pin, PLCC	179237-084
R57	Resistor, 1.5 K $\Omega$ , $\pm$ 5%, 1/8 W	110027-152	<b>Miscellaneous</b>		
R58	Resistor, 3.3 K $\Omega$ , $\pm$ 5%, 1/8 W	110027-332	SW1	Switch, Slide, Spdt	160040-001
R59	Resistor, 1.5 K $\Omega$ , $\pm$ 5%, 1/8 W	110027-152	GND1-GND3	Test Point	179051-001
R60-R62	Resistor, 20 K $\Omega$ , $\pm$ 5%, 1/8 W	110027-203	001HS1	Heatsink, TDA2030	178190-032
R63	Resistor, 47 K $\Omega$ , $\pm$ 5%, 1/8 W	110027-473		Connector, 2 Ckt, Header, .100 Ctr	179048-002
R64	Resistor, 0 $\Omega$ , $\pm$ 5%, 1/4 W	110005-001		Connector, 11 Ckt, Header, .100 Ctr	179118-011
R65, R66	Resistor, 10 $\Omega$ , $\pm$ 5%, 1/8 W	110027-100			

## *Chapter 5*

# Schematic Diagrams

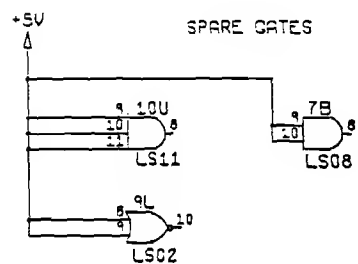
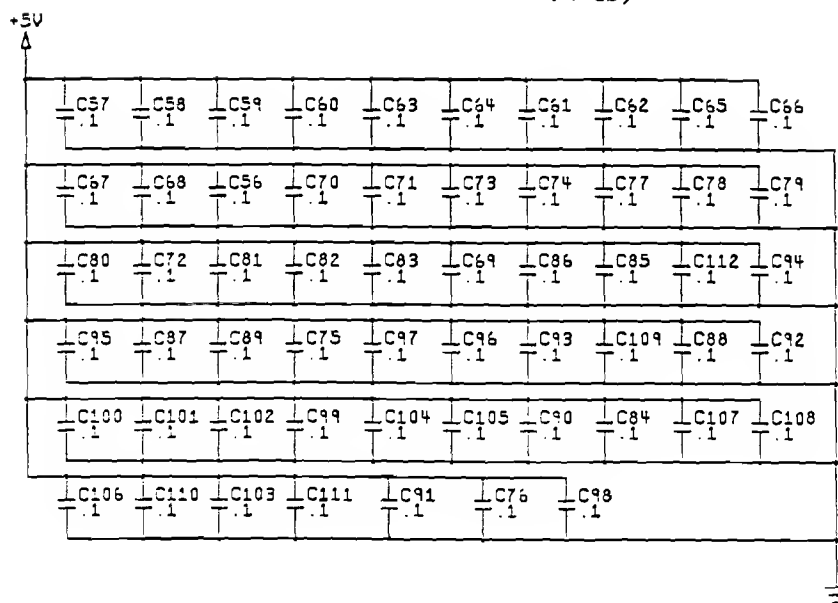
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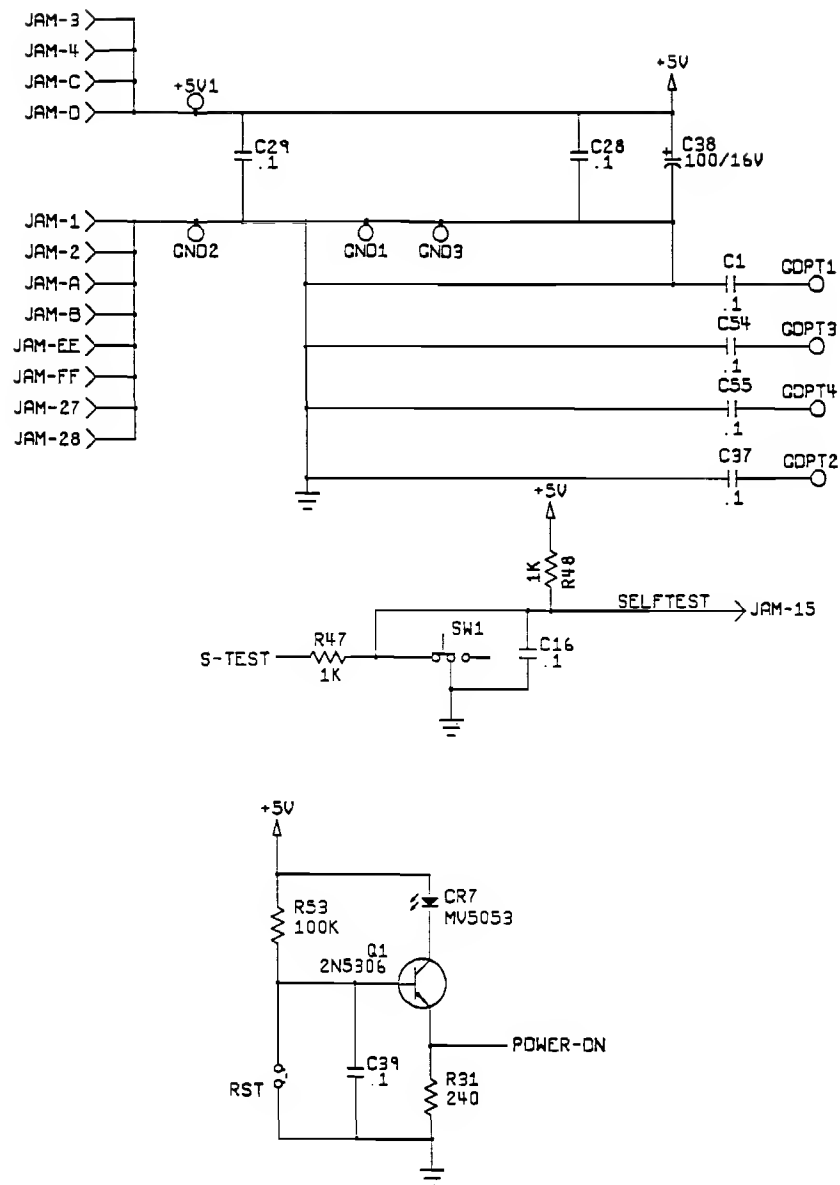


This chapter contains the schematics for your Klax Universal Kit.<sup>™</sup> The Klax Game PCB schematic has nine pages. (The assembly drawing and parts list for the game PCB are shown in Chapter 4, *Illustrated Parts*

*Lists*.) The memory map and the faulty RAM and ROM tables are shown at the end of this chapter. The Klax game does not have an audio PCB.

JAM-H > JAM-24 >  
 JAM-7 > JAM-8B >  
 JAM-K > JAM-25 >  
 JAM-9 > JAM-CC >  
 JAM-S > JAM-26 >  
 JAM-DD >

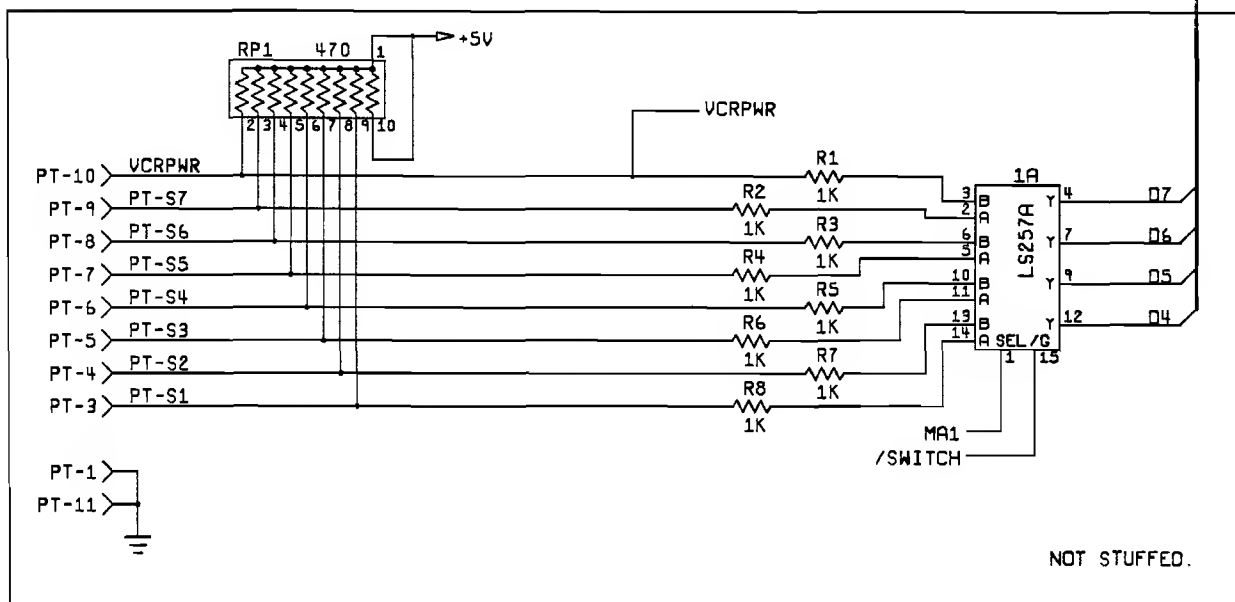
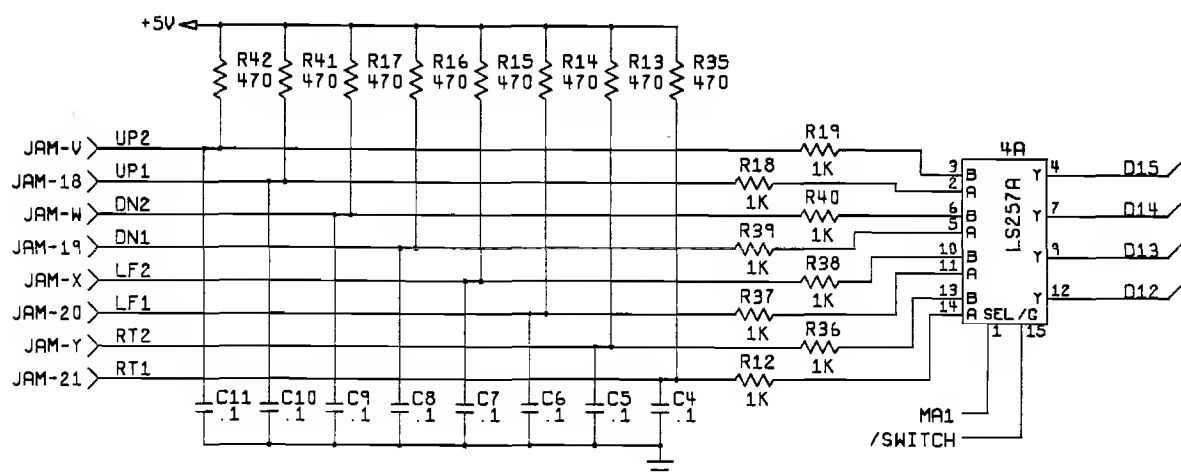
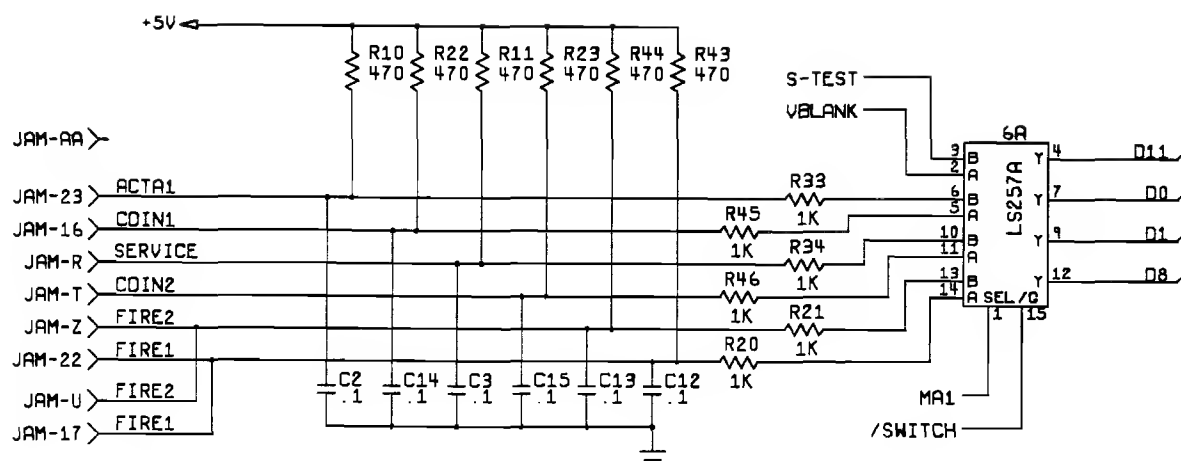




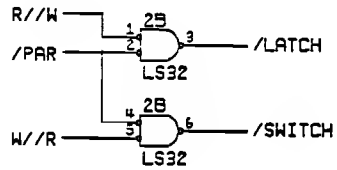
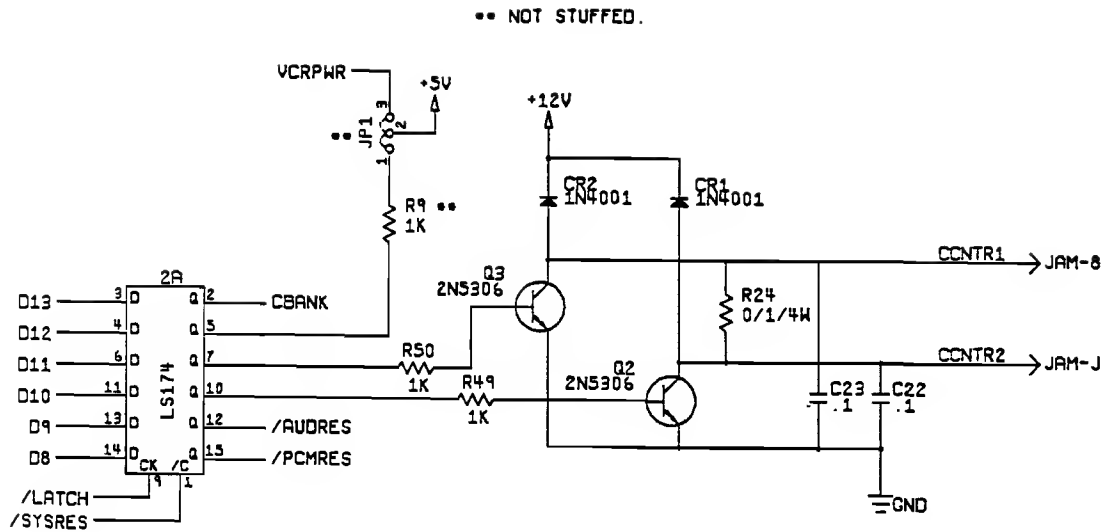
SI/O

**Figure 5-1 Klax Game PCB Assembly Schematic Diagram,  
Sheet 1 of 9**

047438-01 D



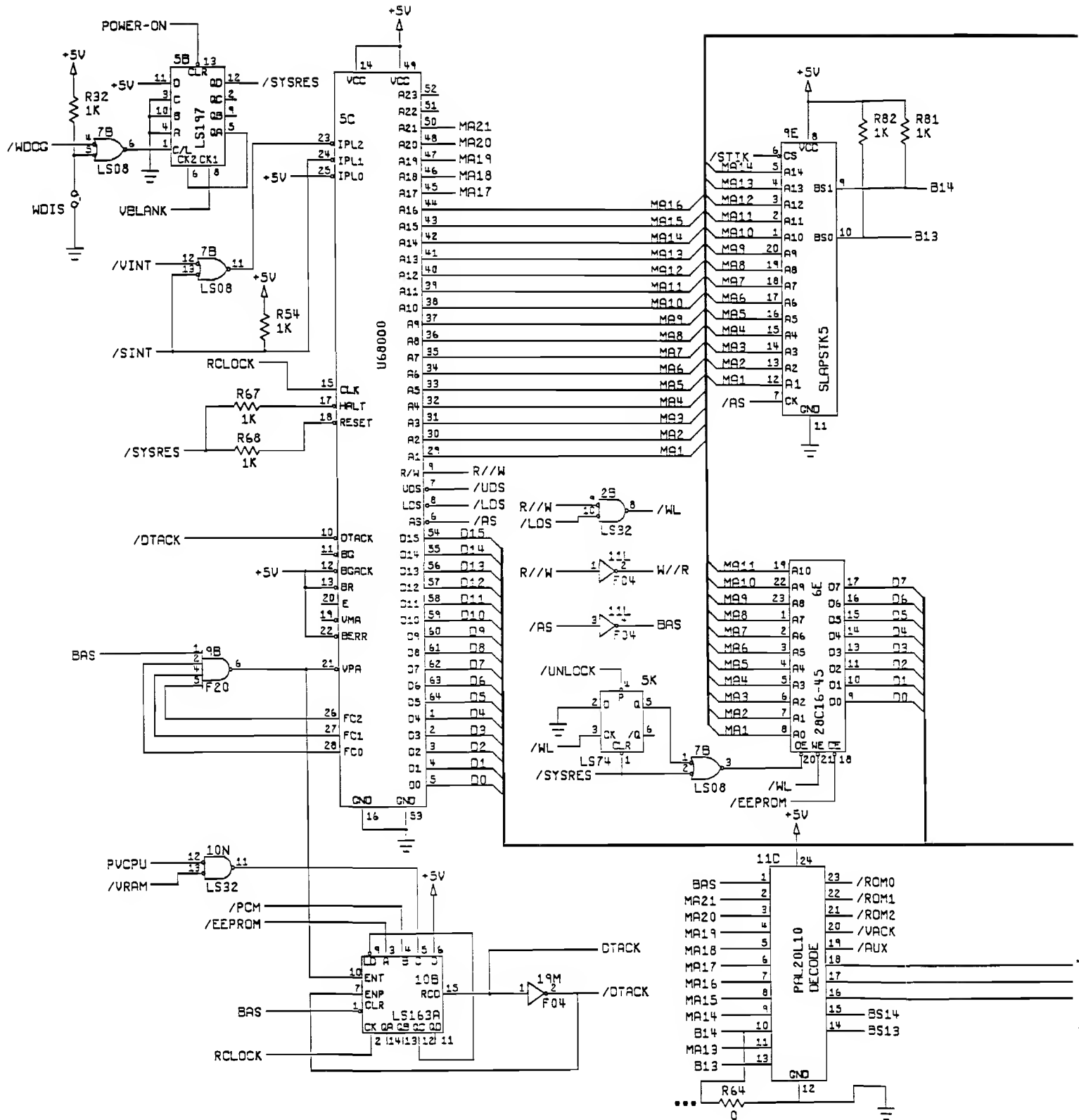


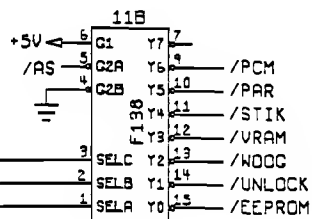
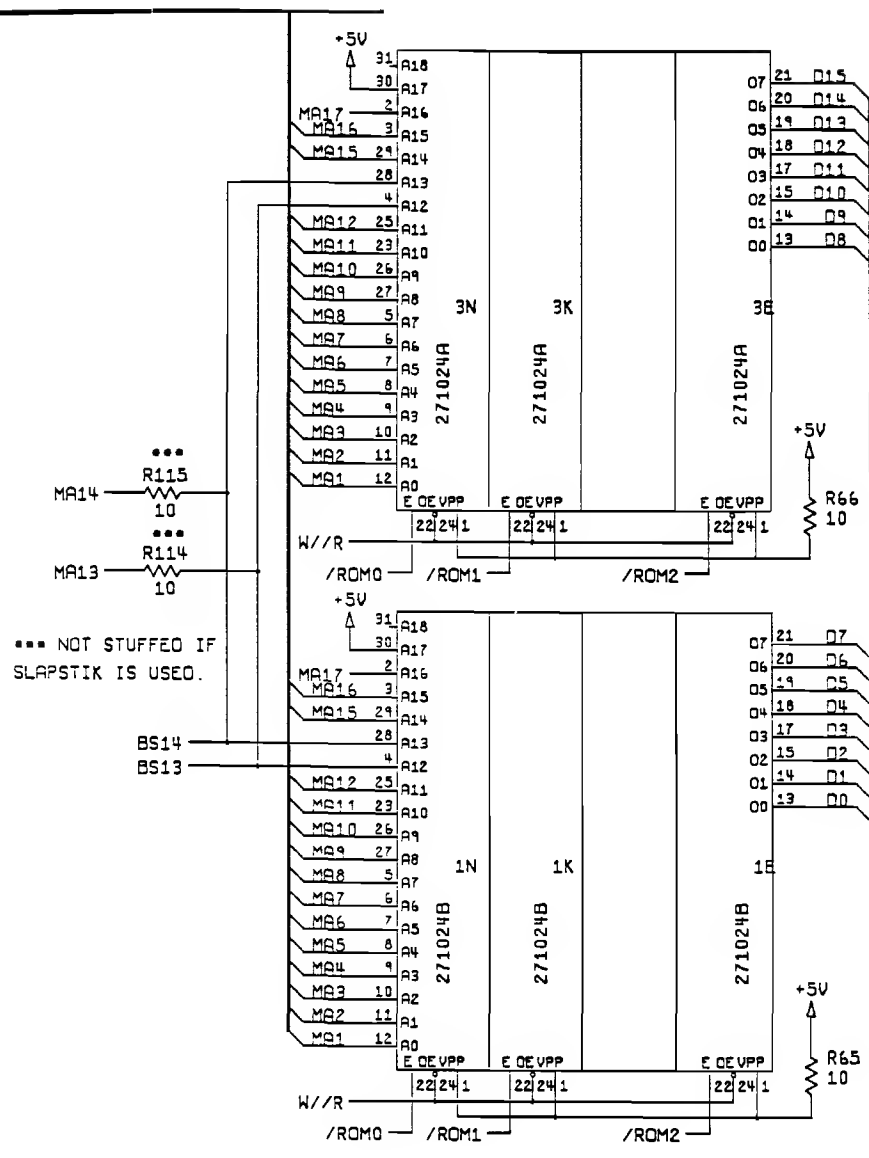


I/O

**Figure 5-1 Klax Game PCB Assembly Schematic Diagram,  
Sheet 2 of 9**

047438-01 D



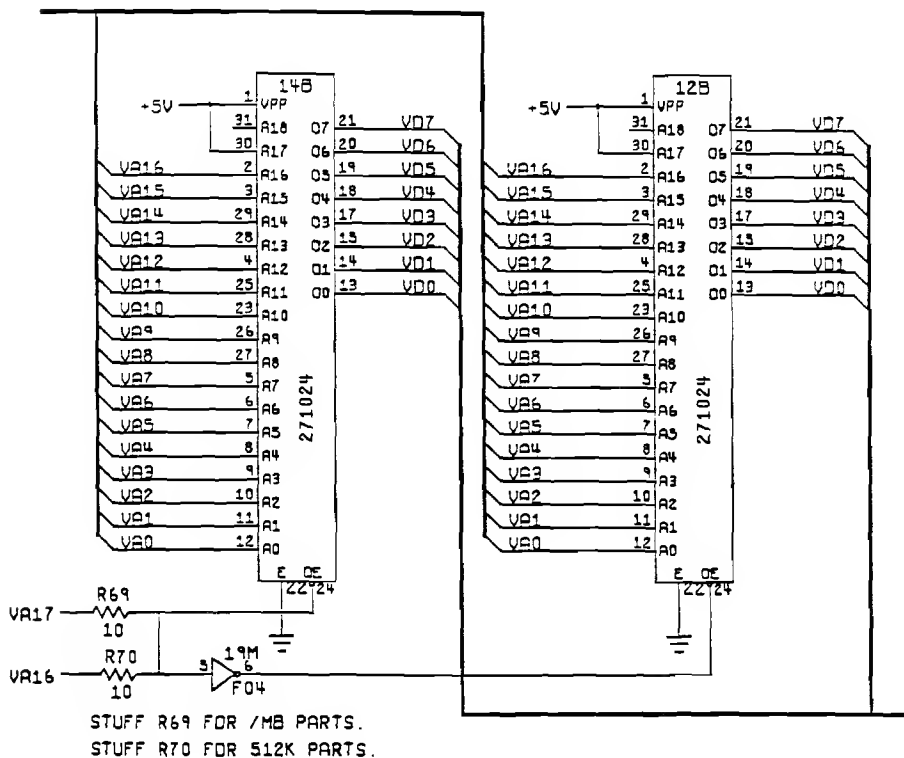
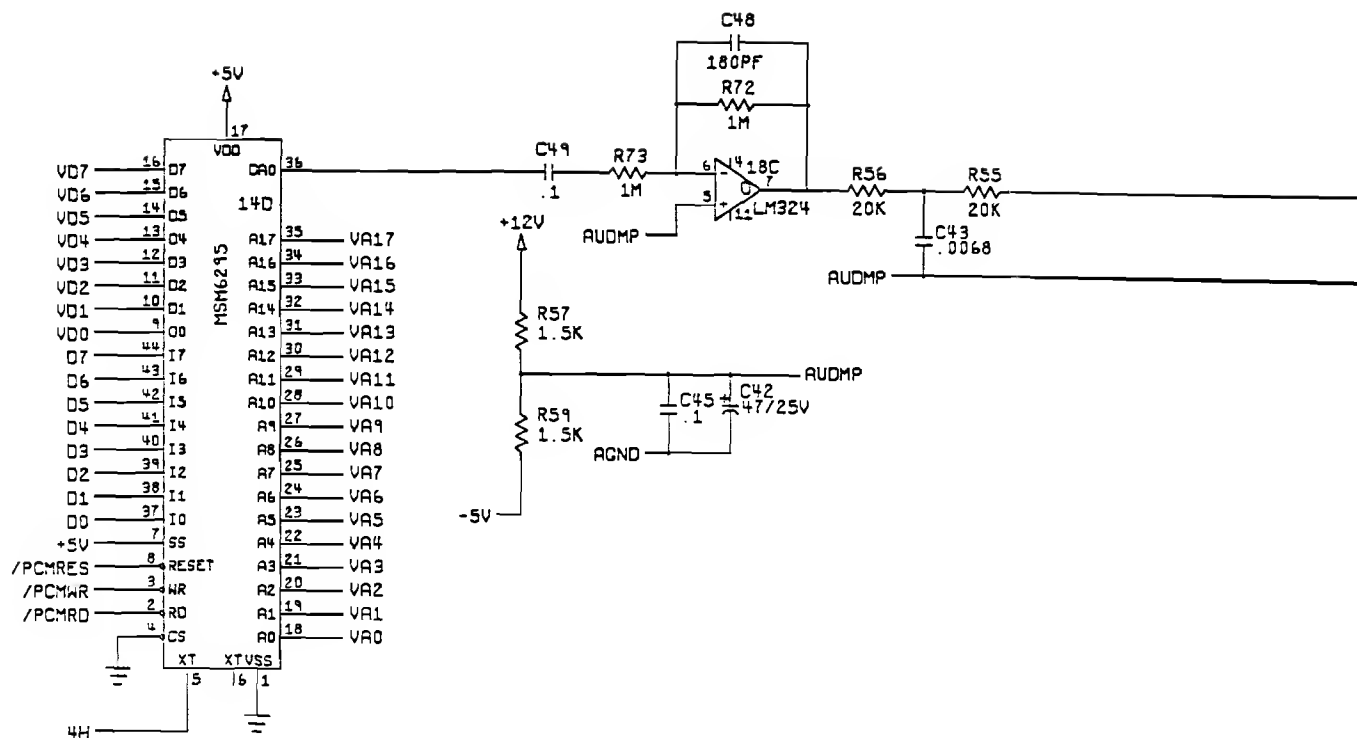


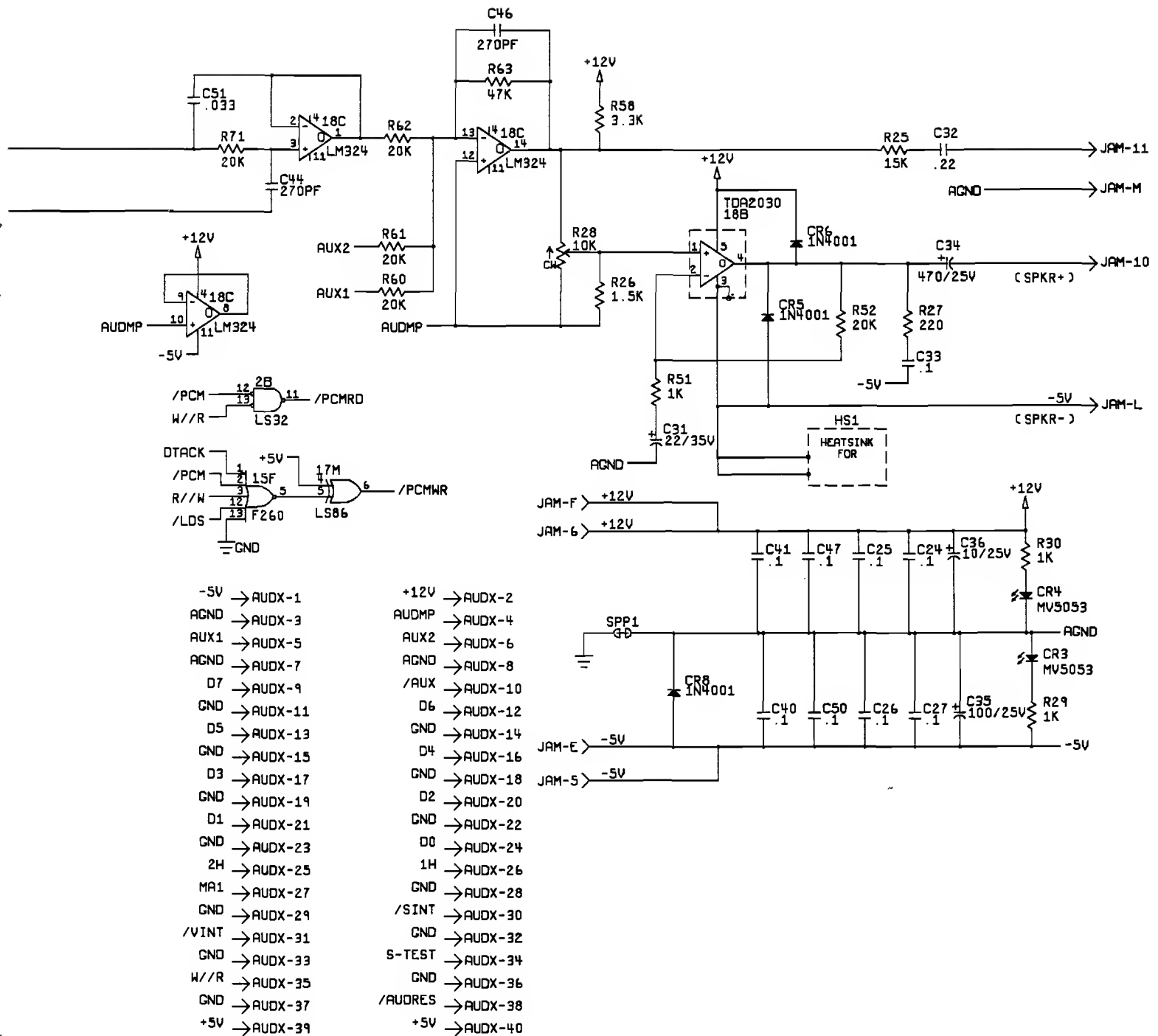
V CPU

NOTE : USE 16L8 IF SLAPSTIK IS NOT USED.

**Figure 5-1 Klax Game PCB Assembly Schematic Diagram,**  
**Sheet 3 of 9**

047438-01 D

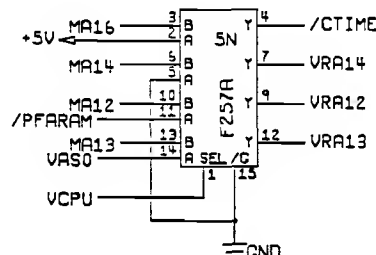


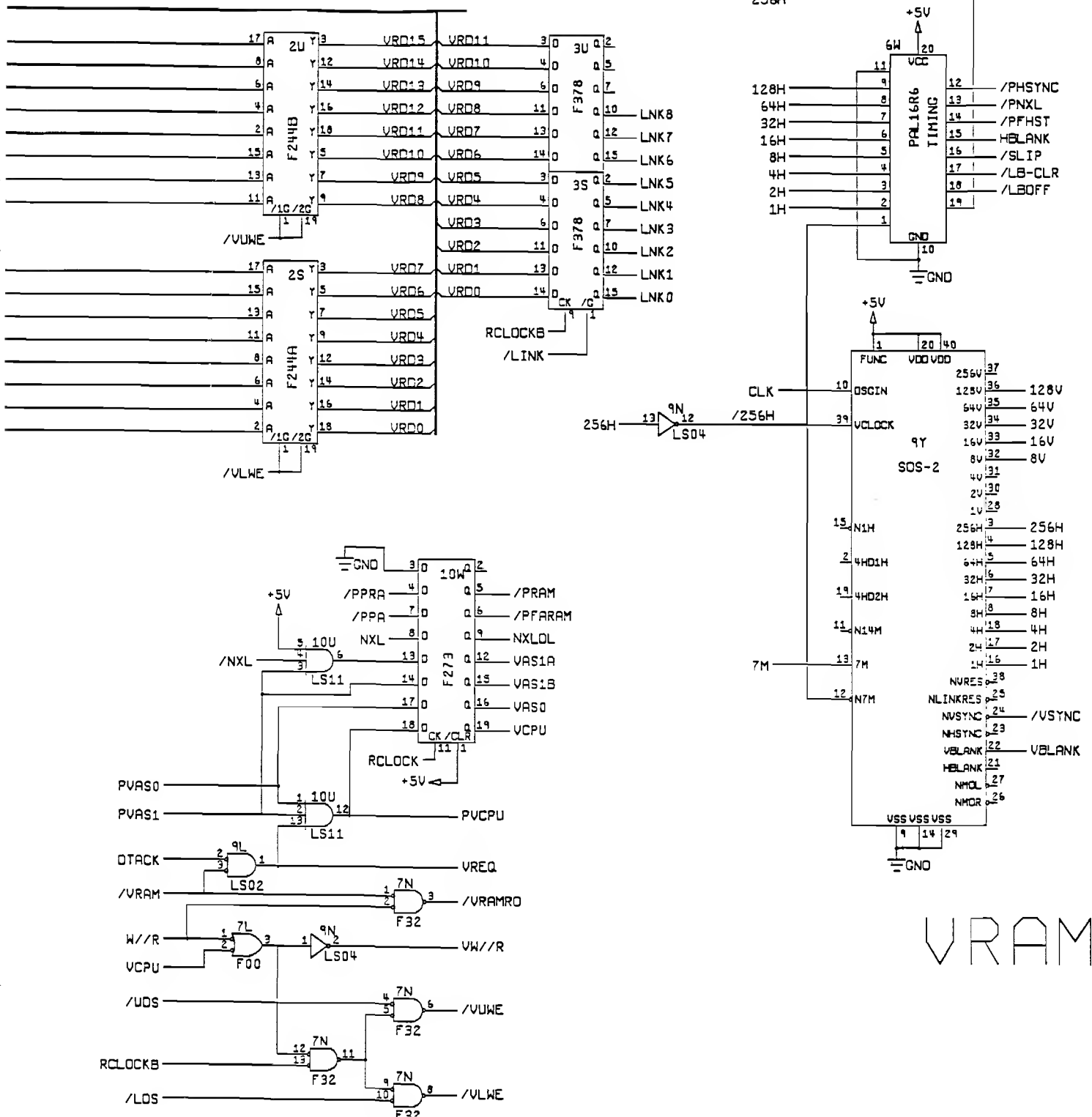


**Figure 5-1 Klax Game PCB Assembly Schematic Diagram,  
Sheet 4 of 9**

047438-01 D

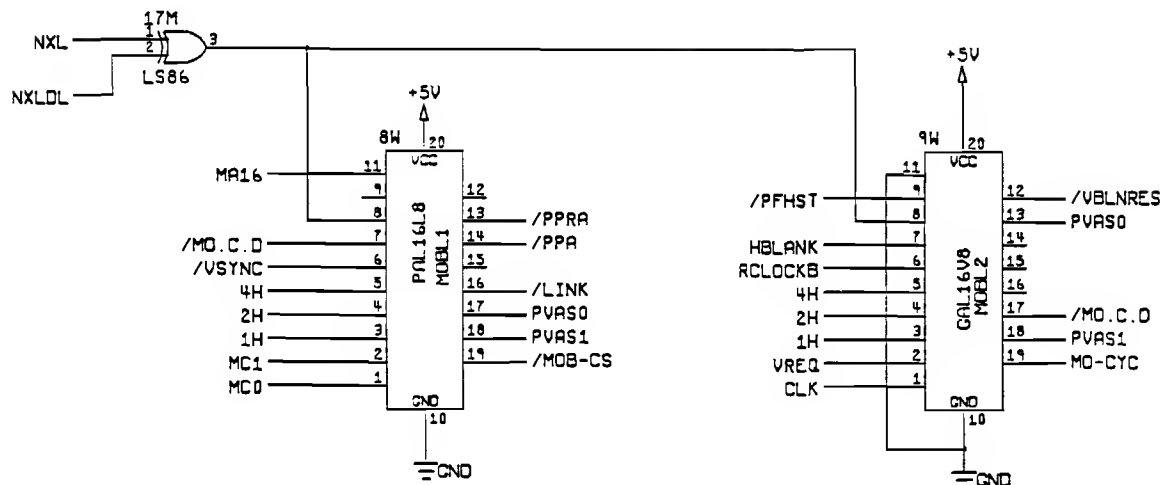
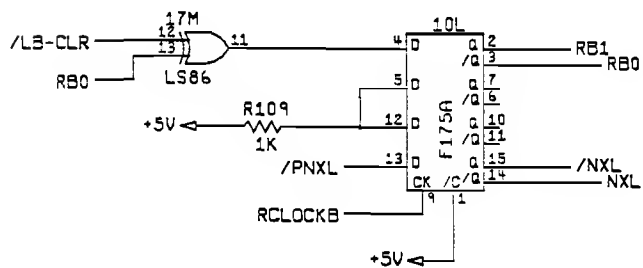
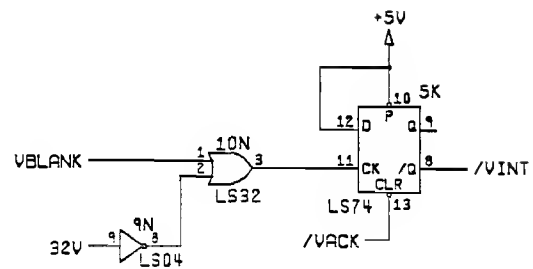
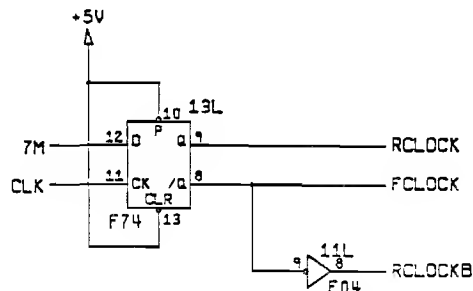
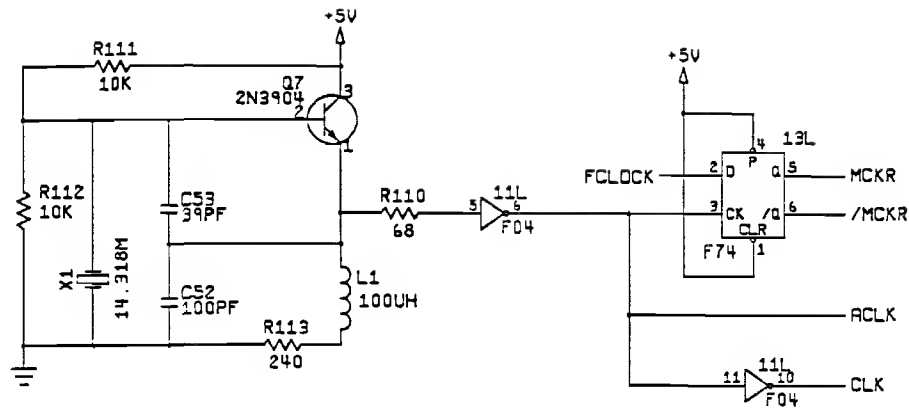


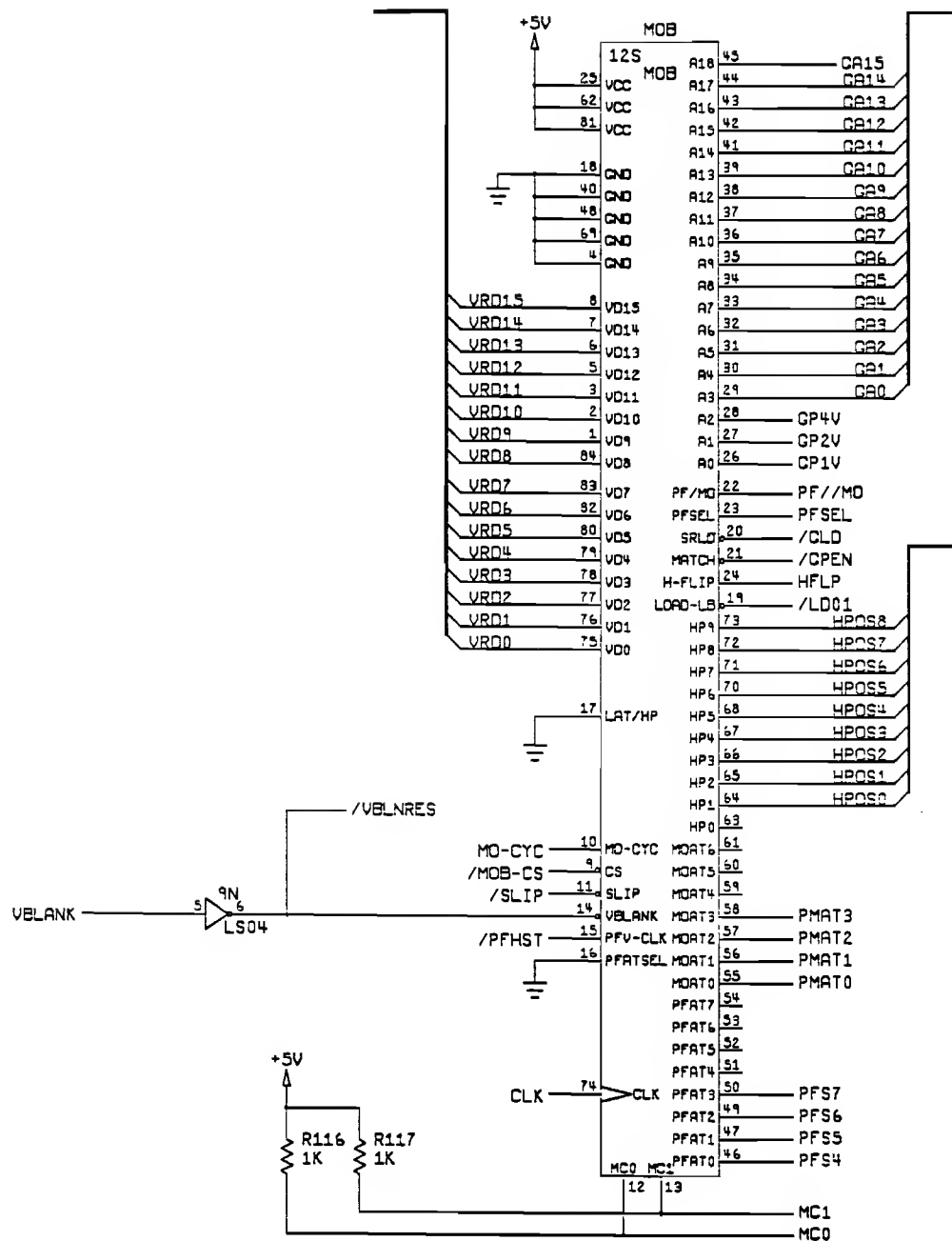




**Figure 5-1 Klax Game PCB Assembly Schematic Diagram,  
Sheet 5 of 9**

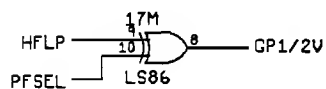
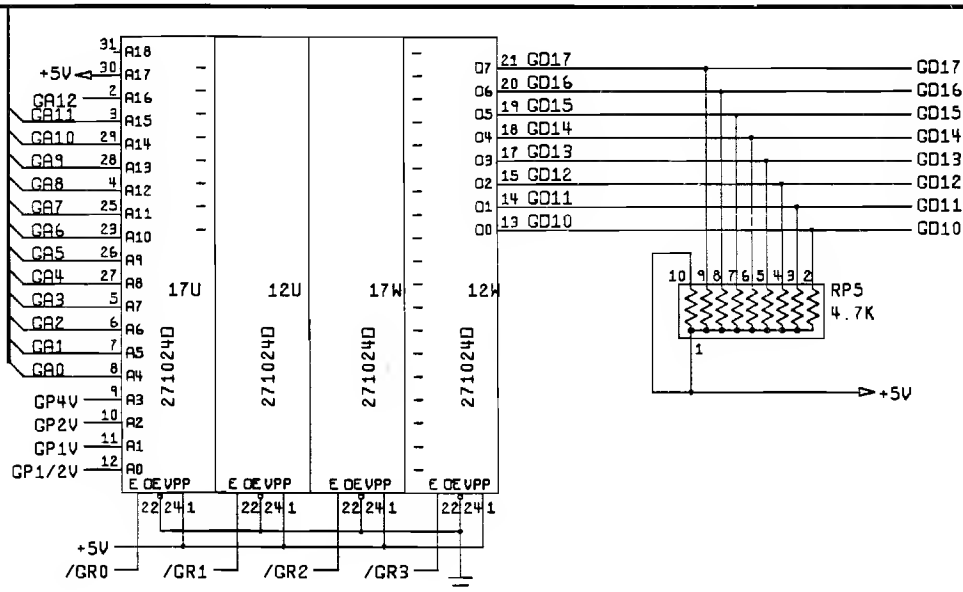
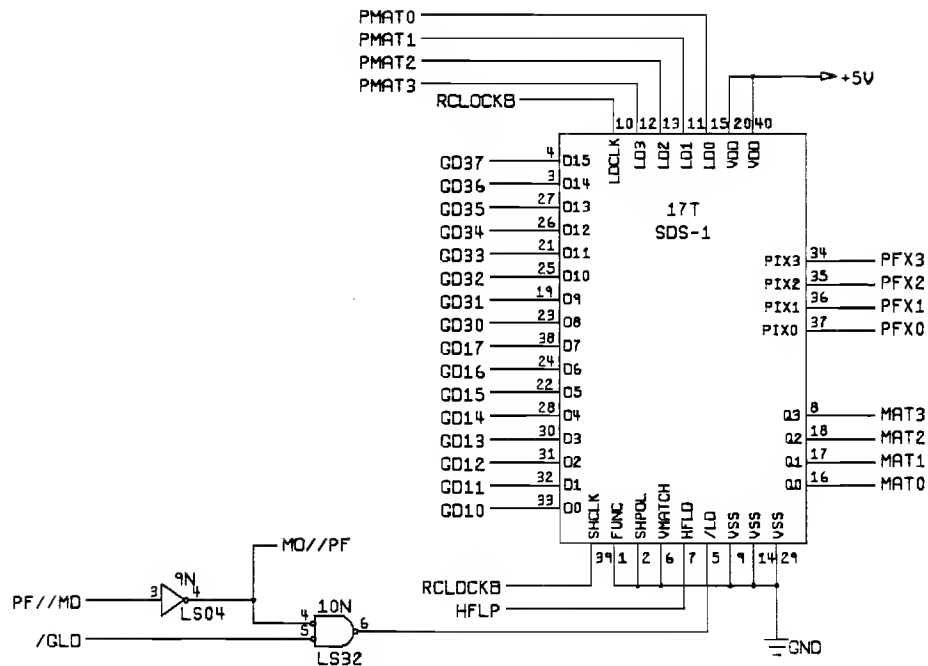
047438-01 D



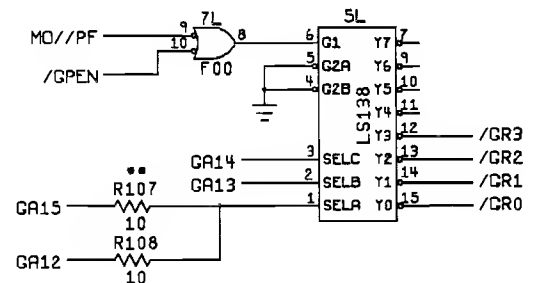


**Figure 5-1 Klax Game PCB Assembly Schematic Diagram,  
Sheet 6 of 9**

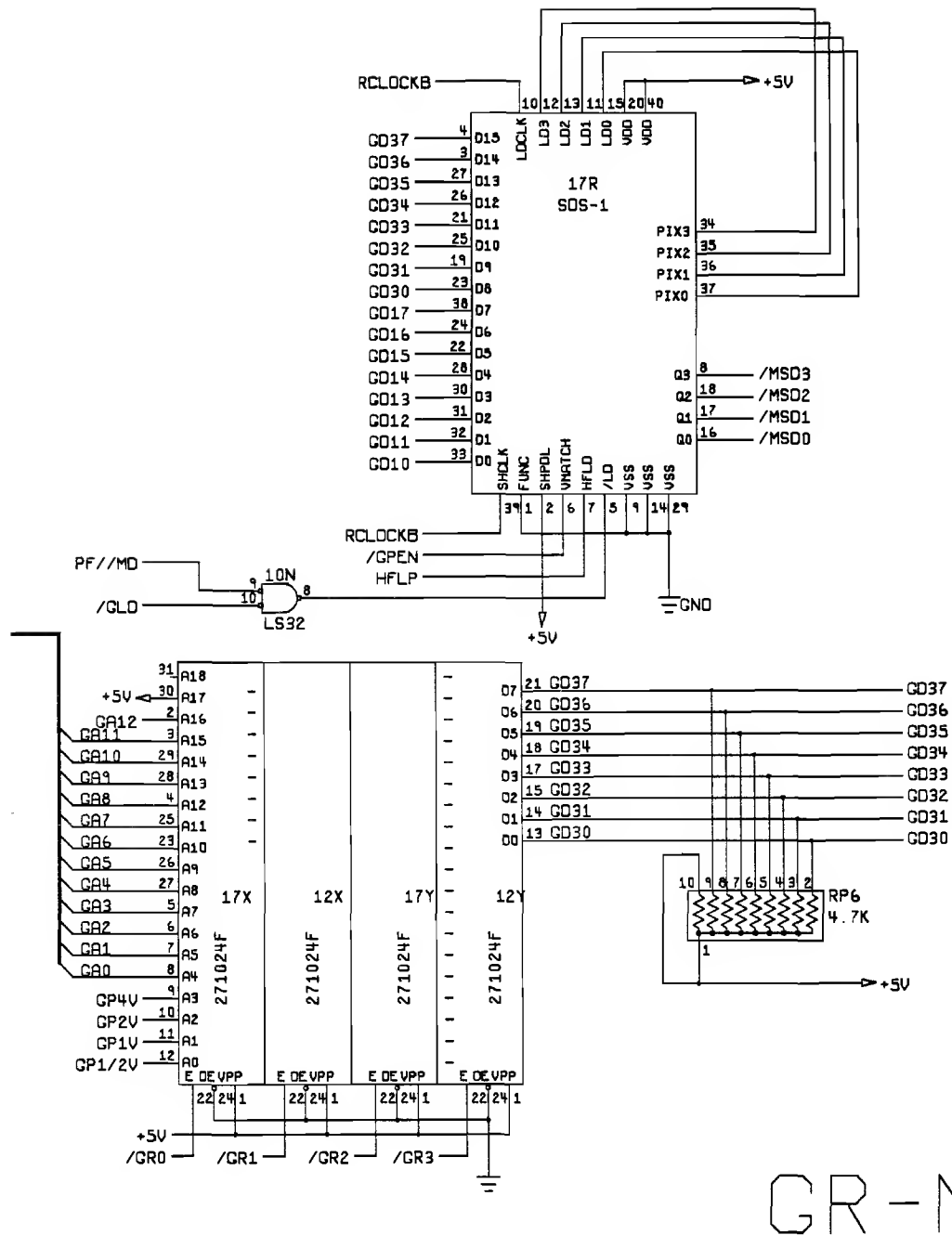
047438-01 D



•• NOT STUFFED.



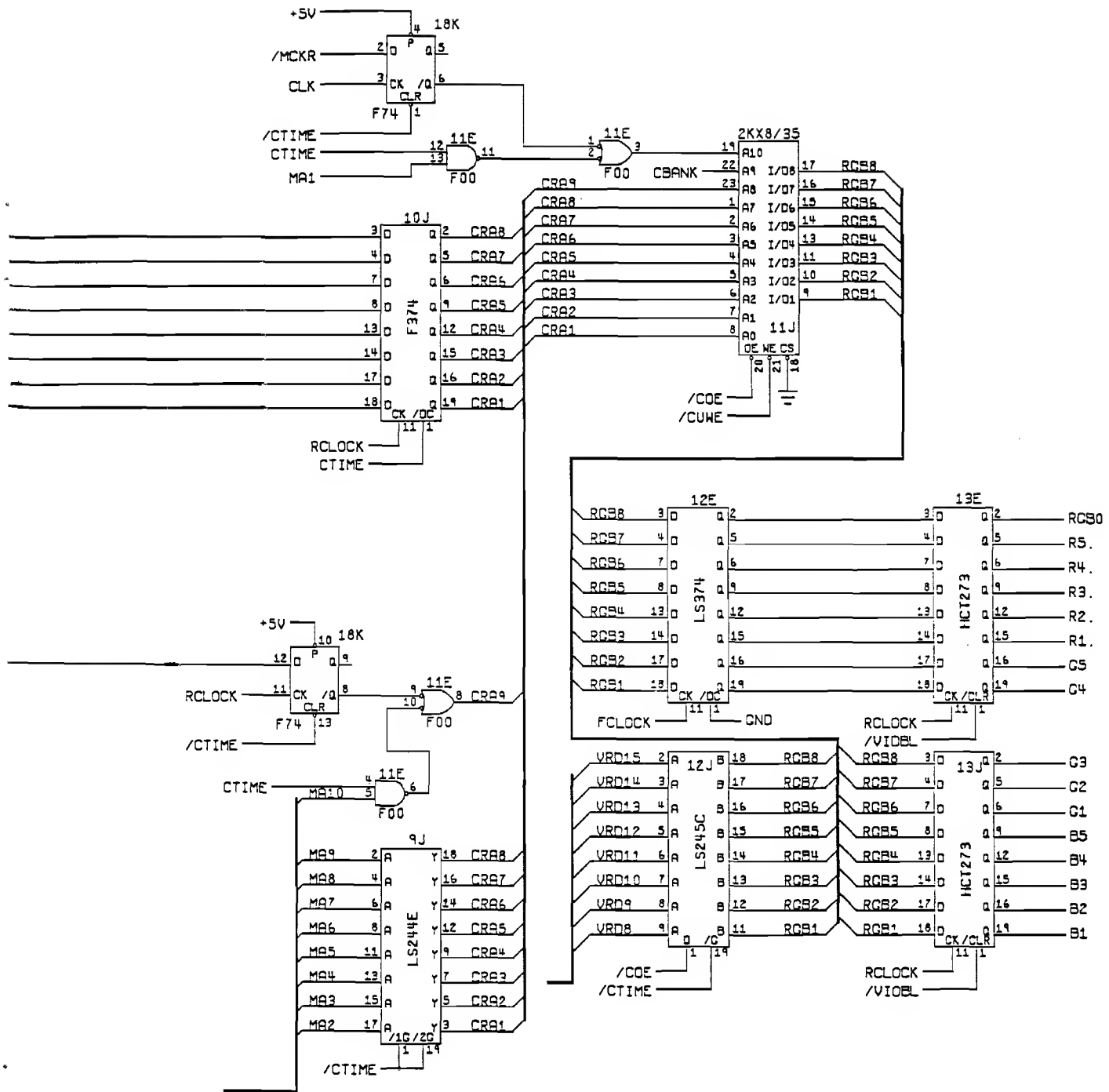




**Figure 5-1 Klax Game PCB Assembly Schematic Diagram,  
Sheet 7 of 9**

047438-01 D

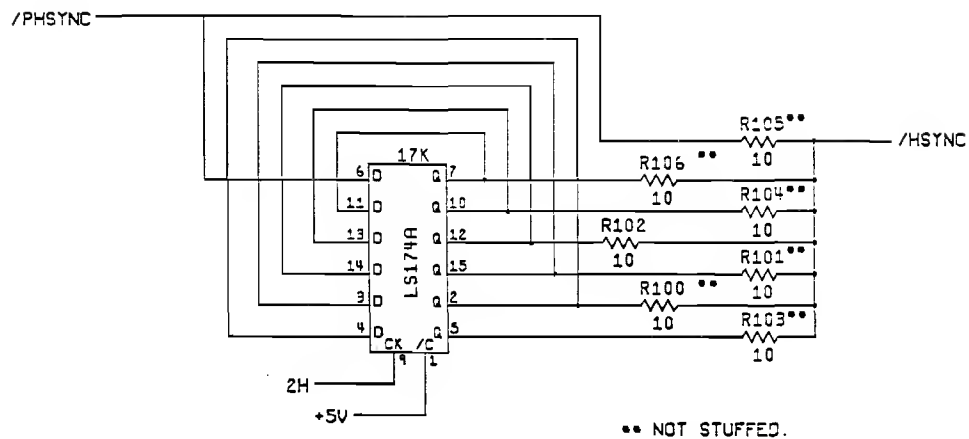
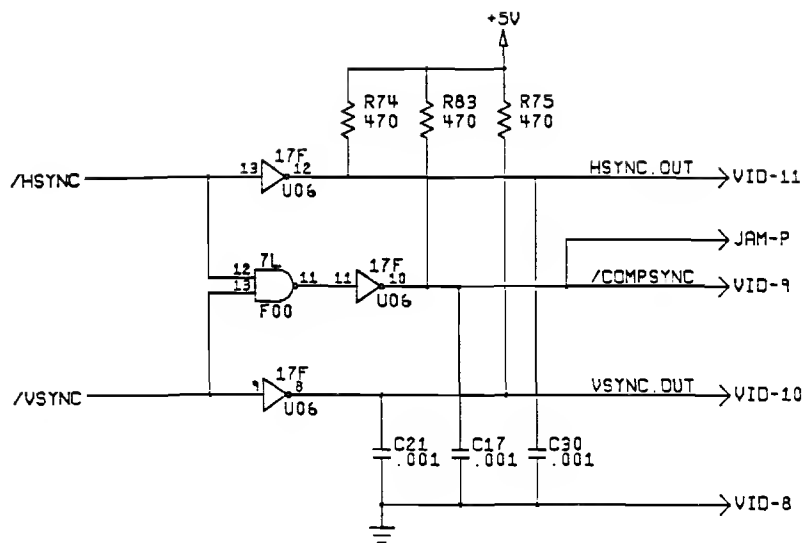


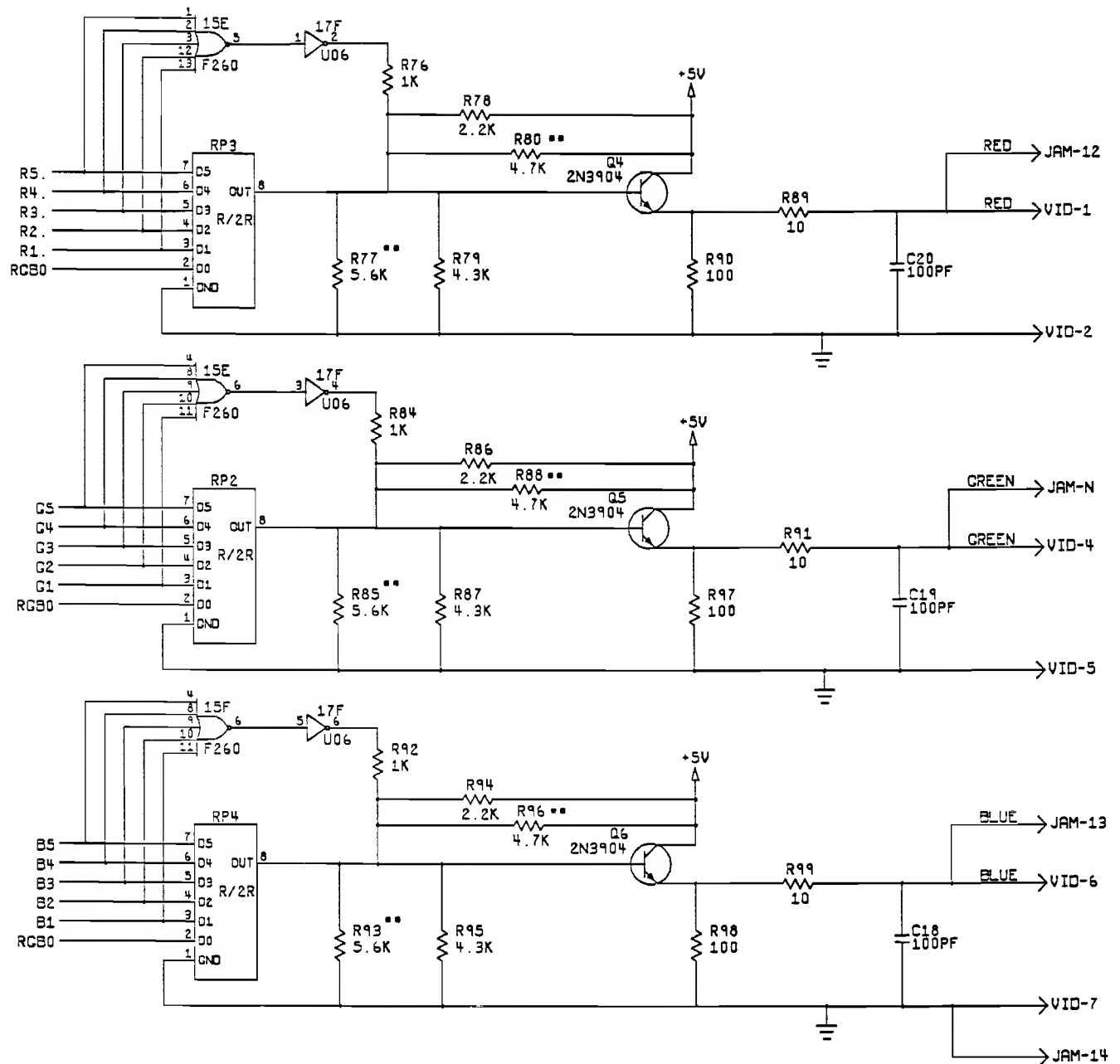


VOUT

Figure 5-1 Klax Game PCB Assembly Schematic Diagram,  
Sheet 8 of 9

047438-01 D





RGB

**Figure 5-1 Klax Game PCB Assembly Schematic Diagram,  
Sheet 9 of 9**

047438-01 D

**Table 5-1 Bad RAM Locations by Error Address**

Error Address	RAM Location	
	High	Low
3F0000	2X	2Y
3E0000	11J	N/A

**Table 5-2 Bad RAM Type by Colored Screens**

Screen Color	RAM Error Location
Red	Working RAM
Green	Playfield RAM
Blue	Motion Object RAM

**Table 5-3 ROM Locations by Error Address**

Error Address	RAM Location	
	High	Low
000000	3N	1N
020000	3K	1K

<b>KLAX Memory Map</b>			
<b>68000 MEMORY-MAP</b>	<b>ADDRESS</b>	<b>R/W</b>	<b>DATA</b>
Program ROM	000000~05FFFF	R	D[15:0]
Program ROM SLAPSTICK	058000~05FFFF	R	D[15:0] (programmable)
EEPROM	0E0001~0E0FFF	R/W	D[7:0] (odd bytes only)
UNLOCK EEPROM	1Fxxxx	W	
Watch Dog	2E0000	W	xx (128 msec. timeout)
Color RAM Motion Object	3E0000~3E03FE	R/W	D[15:8]
Color RAM Playfield	3E0400~3E07FE	R/W	D[15:8]
Playfield picture RAM	3F0000~3F0EFF	R/W	D[15:0]
MOB config	3F0F00~3F0F70	R/W	D[15:0]
SLIP pointers	3F0F80~3F0FFF	R/W	M.O. link pointers
Playfield palette RAM	3F1000~3F1FFF	R/W	D[11:8]
Motion Object RAM	3F2000~3F27FF	R/W	D[15:0]
(Link, Picture, H-Pos, V-Pos, Link... etc.)			
Working RAM	3F2800~3F3FFF	R/W	D[15:0]
Player 1 Input (left)	260000	R	D[15:12], D8 Active lo
Player 2 Input (right)	260002	R	D[15:12], D8 Active lo
D8: flip			
D12: right			
D13: left			
D14: down			
D15: up			
Status inputs	260000	R	D11, D1, D0
D0: coin 1 (left) Active lo			
D1: coin 2 (right) Active lo			
D11: VBLANK Active hi			
Status inputs	260002	R	D11, D1, D0
D0: spare Active lo			
D1: Service Active lo			
D11: Self-test Active lo			
LATCH	260000	W	D[12:8]
D8: ADPCM Chip Reset (active lo)			
D9: Spare			
D10: Coin Counter 2 (right)			
D11: Coin Counter 1 (left)			
D12: spare			
D13: Color RAM bank select			
NOTE: RESET clears this latch			
4ms Interrupt ack.	360000	W	xx
ADPCM Chip	270000	R/W	D[7:0]

**Figure 5-2 Klax Memory Map**





# Klax™ Statistics Sheet

## *Statistics Screen*

Plyr 0 Coins: _____	0 Plyr Mins: _____	L Plyr Mins: _____	Error Count: _____
Plyr 1 Coins: _____	1 Plyr Mins: _____	R Plyr Mins: _____	Total Coins: _____
Total Games _____	2 Plyr Mins: _____		Percentage Play _____

---

## *Histogram Screens*

### **Histogram 1 New Games**

0- 59 \_\_\_\_\_  
60- 89 \_\_\_\_\_  
90-119 \_\_\_\_\_  
120-149 \_\_\_\_\_  
  
150-179 \_\_\_\_\_  
180-209 \_\_\_\_\_  
210-239 \_\_\_\_\_  
240-269 \_\_\_\_\_  
  
270-299 \_\_\_\_\_  
300-329 \_\_\_\_\_  
330-359 \_\_\_\_\_  
360-389 \_\_\_\_\_  
  
390-419 \_\_\_\_\_  
420-449 \_\_\_\_\_  
450-479 \_\_\_\_\_  
480-509 \_\_\_\_\_  
  
510-539 \_\_\_\_\_  
540-569 \_\_\_\_\_  
570-599 \_\_\_\_\_  
600 & \_\_\_\_\_  
up

### **Histogram 2 Continuations**

0- 59 \_\_\_\_\_  
60- 89 \_\_\_\_\_  
90-119 \_\_\_\_\_  
120-149 \_\_\_\_\_  
  
150-179 \_\_\_\_\_  
180-209 \_\_\_\_\_  
210-239 \_\_\_\_\_  
240-269 \_\_\_\_\_  
  
270-299 \_\_\_\_\_  
300-329 \_\_\_\_\_  
330-359 \_\_\_\_\_  
360-389 \_\_\_\_\_  
  
390-419 \_\_\_\_\_  
420-449 \_\_\_\_\_  
450-479 \_\_\_\_\_  
480-509 \_\_\_\_\_  
  
510-539 \_\_\_\_\_  
540-569 \_\_\_\_\_  
570-599 \_\_\_\_\_  
600 & \_\_\_\_\_  
up



# Glossary

## AC

Alternating current; from zero it rises to a maximum positive level, then passes through zero again to a maximum negative level.

## ACTIVE STATE

The true state of a signal. For example: The active state for is low.

## ADDRESS

A value that identifies a specific location of data in memory; normally expressed in hexadecimal notation.

## ANALOG

Measurable in an absolute quantity (as opposed to on or off). Analog devices are volume controls, light dimmers, stereo amplifiers, etc.

## ANODE

The positive (arrow) end of a diode.

## AMPLIFIER

A device used to increase the strength of an applied signal.

## AMPLITUDE

The maximum instantaneous value of a waveform pulse from zero.

## ASTABLE

Having no normal state. An astable device will free-run or oscillate as long as operating voltage is ap-



plied. The oscillation frequency is usually controlled by external circuitry.

## AUXILIARY COIN SWITCH

A momentary-contact pushbutton switch with a black cap located on the utility panel. The auxiliary coin switch adds credits to the game without activating a coin counter.

## BEZEL

A cut, formed, or machined retention device, such as the conical device used to mount a pushbutton switch to a control panel, or the formed device used to frame the video display screen.

## BIDIRECTIONAL

Able to send or receive data on the same line (e.g., the data bus of a microprocessor).

## BINARY

A number system that expresses all values by using two digits (0 and 1).

## BIT

A binary digit; expressed as 1 or 0.

## BLANKING

Turning off the beam on a cathode-ray tube during retrace.

## BLOCK DIAGRAM

A drawing in which functional circuitry units are represented by blocks. Very useful during initial troubleshooting.

## BUFFER

1. An isolating circuit designed to eliminate the reaction of a driven circuit on the circuits driving it (e.g., a buffer amplifier).

2. A device used to supply additional drive capability.

## BUS

An electrical path over which information is transferred from any of several sources to any of several destinations.

## CAPACITOR

A device capable of storing electrical energy. A capacitor blocks the flow of DC current while allowing AC current to pass.

## CATHODE

The negative end of a diode.

## CHIP

An integrated circuit comprising many circuits on a single wafer slice.

## CLOCK

A repetitive timing signal for synchronizing system functions.

## COINCIDENCE

Occurring at the same time.

## COIN COUNTER

A 6-digit electromechanical device that counts the coins inserted in the coin mechanism(s).

## COIN MECHANISM

A device on the inside of the coin door that inspects the coin to determine if the correct coin has been inserted.

## COMPLEMENTARY

Having opposite states, such as the outputs of a flip-flop.

## COMPOSITE SYNC

Horizontal and vertical synchronization pulses that are bused together into a single signal. This signal provides the timing necessary to keep the display in synchronization with the game circuitry.

## COMPOSITE VIDEO

Complete video signal from the game system to drive the display circuitry, usually comprising H SYNC, V SYNC, and the video.

## CREDIT

One play for one person based on the game switch settings.

## CRT

Cathode-ray tube.

## DATA

General term for the numbers, letters, and symbols that serve as input for device processing.

## DARLINGTON

A two-transistor amplifier that provides extremely high gain.

## DC

Direct current, meaning current flowing in one direction and of a fixed value.

## DEFLECTION YOKE

Electromagnetic coils around the neck of a cathode-ray tube. One set of coils deflects the electron beam horizontally and the other set deflects the beam vertically.

## DIAGNOSTICS

A programmed routine for checking circuitry. For example: the self-test is a diagnostic routine.

## DIODE

A semiconductor device that conducts in only one direction.

## DISCRETE

Non-integrated components, such as resistors, capacitors, and transistors.

## DMA

Direct memory access. DMA is a process of accessing memory that bypasses the microprocessor logic. DMA is normally used for transferring data between the input/output ports and memory.

**DOWN TIME**

The period during which a game is malfunctioning or not operating correctly due to machine failure.

**EAROM**

Electrically alterable read-only memory (see ROM). The EAROM is a memory that can be changed by the application of high voltage.

**FLYBACK**

A step-up transformer used in a display to provide the high voltage.

**GATE**

1. A circuit with one output that responds only when a certain combination of pulses is present at the inputs.

2. A circuit in which one signal switches another signal on and off.

3. To control the passage of a pulse or signal.

**HARNESS**

A prefabricated assembly of insulated wires and terminals ready to be attached to a piece of equipment.

**HEXADECIMAL**

A number system using the equivalent of the decimal number 16 as a base. The symbols 0-9 and A-F are usually used.

**IMPLODE**

To burst inward; the inward collapse of a vacuum tube.

**I/O**

Input/Output.

**IRQ**

Interrupt request. IRQ is a control signal to the microprocessor that is generated by external logic. This signal tells the microprocessor that external logic needs attention. Depending on the program, the processor may or may not respond.

**LED**

The abbreviation for a light-emitting diode.

**LOCKOUT COIL**

Directs coins into the coin return box when there is no power to the game.

**LOGIC STATE**

The binary (1 or 0) value at the node of a logic element or integrated circuit during a particular time. Also called the logic level. The list below shows the voltage levels corresponding to the logic states (levels) in a TTL system.

*Logic 0, Low* = 0 VDC to +0.8 VDC

*Grey Area (Tri-State Level)* = +0.8 VDC to +2.4 VDC

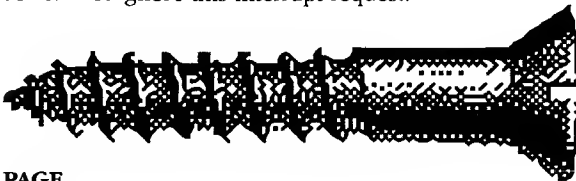
*Logic 1, High* = +2.4 VDC to +5 VDC

**MULTIPLEXER**

A device that takes several low-speed inputs and combines them into one high-speed data stream for simultaneous transmission on a single line.

**NMI**

Non-maskable interrupt. NMI is a request for service by the microprocessor from external logic. The microprocessor cannot ignore this interrupt request.

**PAGE**

A subsection of memory. A read-only memory device (see ROM) is broken into discrete blocks of data. These blocks are called pages. Each block has X number of bytes.

**PCB**

The abbreviation for a printed-circuit board.

**PHOTOTRANSISTOR**

A transistor that is activated by an external light source.

**POTENTIOMETER**

1. A resistor that has a continuously moving contact which is generally mounted on a moving shaft. Used chiefly as a voltage divider. Also called a pot (slang).

2. An instrument for measuring a voltage by balancing it against a known voltage.

**RAM**

Random-access memory. A device for the temporary storage of data.

**RASTER-SCAN DISPLAY**

A display system whereby images are displayed by continuously scanning the cathode-ray tube horizontally and vertically with an electron beam. The display system controls the intensity of the electron beam.

**RETRACE**

In a raster-scan display, retrace is the time during which the cathode-ray tube electron beam is resetting either from right to left or from bottom to top.

**RESISTOR**

A device designed to have a definite amount of resistance. Used in circuits to limit current flow or to provide a voltage drop.

**ROM**

Read-only memory. A device for the permanent storage of data.

**SIGNATURE ANALYSIS**

A process of isolating digital logic faults at the component level by means of special test equipment called signature analyzers. Basically, signature analyzers (e.g., the ATARI® CAT Box) convert

lengthy bit streams into four-digit hexadecimal signatures. The signature read by the analyzer at each circuit node is then compared with the known good signature for that node. This process continues until a fault is located.

**TROUBLESHOOT**

The process of locating and repairing a fault.

**VECTOR**

A line segment drawn between specific X and Y coordinates on a cathode-ray tube.

**WATCHDOG**

A counter circuit designed to protect the microprocessor from self-destruction if a program malfunction occurs. If a malfunction does occur, the counter applies continuous pulses to the reset line of the microprocessor, which causes the microprocessor to keep resetting.

**X-Y DISPLAY**

A display system whereby images are displayed with vectors.

**ZENER DIODE**

A special diode used as a regulator. Its main characteristic is breaking down at a specified reverse-bias (Zener) voltage.

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Seller warrants that its printed-circuit boards and parts thereon are free from defects in material and workmanship under normal use and service for a period of ninety (90) days from date of shipment. Seller warrants that its video displays and laser-video disc players (in games supplied with displays and video-disc players) are free from defects in material and workmanship under normal use and service for a period of thirty (30) days from date of shipment. None of the Seller's other products or parts thereof are warranted.

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- (a) Seller is promptly notified in writing upon discovery by Buyer that said products are defective;
- (b) Such products are returned prepaid to Seller's plant; and
- (c) Seller's examination of said products discloses to Seller's satisfaction that such alleged defects existed and were not caused by accident, misuse, neglect, alteration, improper repair, installation, or improper testing.

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